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**РД-9Б JET ENGINE
FUEL SYSTEM UNITS**

**HP-10A, HP-11A, HP-10AKC AND HP-11BA UNITS
DESCRIPTION AND MAINTENANCE INSTRUCTIONS**



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HP-10A AND HP-11A UNITS

1. GENERAL

The HP-10A unit (Fig.1) is designed to supply fuel to the main fuel system of the PJ-9B turbo-jet engine and to control automatically the operation of this system.

The unit comprises a high pressure variable-displacement plunger pump, a variable speed automatic governor with a hydraulic decelerator and acceleration control unit, a throttle valve with a constant pressure drop valve, a distributing valve, a starting control unit, an interlocking limit switch of the decelerator, and a minimum pressure valve.

The plunger fuel pump provides for fuel delivery in amounts and at a pressure necessary to maintain the required engine r.p.m. The pump has seven plungers spaced around the revolving rotor.

A wobble plate (with a special thrust ball bearing) and a servomechanism of the centrifugal governor control the plungers stroke.

The engine speed is governed by a control lever. By operating the lever the pilot adjusts the transmitter spring of the centrifugal governor and the metering needle to maintain the required engine r.p.m.

A slide valve is incorporated in the unit to regulate fuel flow under low speed conditions.

The HP-10A unit comprises an acceleration control unit which maintains the desired fuel delivery to facilitate normal acceleration of the engine.

The HP-11A unit (Figs 3 and 4) automatically regulates the fuel flow and feeds the afterburner fuel system of the PJ-9B turbo-jet engine.

The HP-11A unit includes a high pressure variable-displacement plunger pump, a barostat, an afterburner valve, cut-off and fuel flow control valves, an electromagnetic switch, constant pressure and fuel bypass valves, and an interlocking device switch.

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The pump has nine plungers arranged along the rotor circumference. A wobble plate (with a specially designed thrust ball bearing), whose operation depends on the position of the servopiston, governs the plungers stroke and, consequently, the pump fuel delivery. The barostat adjusts fuel pressure in the afterburner valve pipe line depending on the ambient air pressure thereby controlling the operation of the servopiston.

A special electromagnetic valve opens and closes the afterburner valve.

11. BASIC SPECIFICATIONS OF HP-10A UNIT

1. Dia. of pump plungers 14 mm
2. Number of plungers 7
3. Direction of pump rotor motion
(as viewed from the shaft) right-hand
4. $\frac{n_{\text{pump}}}{n_{\text{engine}}}$ ratio 0.32
5. Fuel pressure at unit inlet 1.6 -
-2.6 kg/cm²
6. Maximum fuel pressure at unit outlet
in burner primary manifold 80 kg/cm²
7. Pump rotor maximum r.p.m. 3565⁺³⁰₋₁₀
8. Maximum output at pump speed of
3500 r.p.m. and 80 kg/cm² fuel pressure in primary manifold of burners. 4180⁺²⁰⁰ lit/hr
9. Unit weight, max. 17.5 kg

HP-11A Unit

1. Pump plunger dia. 15 mm
2. Number of plungers 9
3. Pump rotor sense of rotation (as viewed
from shaft side) right-hand
4. $\frac{n_{\text{pump}}}{n_{\text{engine}}}$ ratio 0.32
5. Fuel pressure at unit inlet 1.8-3.4 kg/cm²
(3.6 kg/cm² for short periods of time)
6. Maximum fuel pressure at unit outlet in
burners manifold 90 kg/cm²
7. Pump rotor maximum r.p.m. 3565⁺²⁰
8. Maximum output at pump speed of 3565 r.p.m.
(is achieved by placing maximum feed stop
against pump wobble plate) 3620 -
3740 lit/hr
9. Unit weight, max. 14 kg
10. Grade of fuel T-1 State Standard (TCGT
4153-49) or TC-1

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III. HP-10A UNIT. PRINCIPLE OF OPERATION

Fuel Supply System

Fig.5 shows the Key diagram of the HP-10A unit. Safety filter 1 is installed at the unit inlet. Having passed through the filter, fuel via a low pressure chamber flows to ported member 3 of the pump rotor. Thence fuel is delivered into high pressure duct 19. The principle of the pump operation is as follows. When rotor 7 is turned, plungers 8 resting against the tapered surface of thrust bearing 13 (the wobble plate) reciprocate in the rotor holes. Springs 9 and fuel pressure in the rotor sockets constantly press the plungers to the bearing.

The face of running rotor 7 sliding along ported member 3 is pressed to the latter by the plunger springs and fuel pressure in the plunger sockets.

The centrifugal force of fuel (admitted from seven oblique holes spaced in the rotor among the plunger holes) also presses the rotor to the ported member.

The ported member has two semi-circular ports - suction port 4 and delivery port 5. When the plungers move towards the wobble plate fuel is sucked into the cavity under the plunger of the rotor through port 4 during approximately half a turn of the rotor. During the second half turn the plunger moves backwards and through port 5 forces the fuel into the high pressure line.

The greater the wobble plate-to-thrust bearing angle the longer is the plunger travel and, consequently, the greater is the pump output. With increase in the rotor r.p.m. the pump capacity goes up, since this increases the number of plunger strokes (Fig.6 shows dependence of fuel consumption on the engine r.p.m.). High pressure fuel flow runs to throttle valve 35 via duct 19; thence through duct 52 it is delivered to distributing valve 70.

Key diagram 5 illustrates distributing valve 70 in the open position. With the engine running the valve opens and distributes fuel among the fuel burner manifolds. The distributing valve starts operating at relatively low pressure (4[±]1 kg/cm²). Concurrently only part of duct 71 cross-section area opens. Fuel via duct 71 flows to burners primary manifold through a triangular slit in the valve bushing; the slit area increases as the fuel pressure rises.

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At $8.5 \pm 1 \text{ kg/cm}^2$ fuel pressure, the cross-section of duct 72 opens and fuel is allowed into the main manifold of the burners. This construction of the distributing valve provides for variations in fuel consumption depending on fuel pressure at the distributing valve inlet. Fig. 7 shows fuel pressure variations in the main and primary manifolds.

HP-10A Unit Automatic Devices

General

The automatic devices of the HP-10A unit fuel supply and control systems are designed to provide for the following tasks:

1. to maintain the pre-set engine r.p.m. with required accuracy irrespective of flight altitude and speed;
2. to ensure smooth decrease or increase of the engine r.p.m. when the throttle lever is being shifted to either direction;
3. to accelerate the engine without overheating and surge at any rate of throttle lever displacement;
4. to distribute fuel between the manifolds according to the required setting.

One common lever 34 interconnected with the control lever in the pilot's cockpit ensures the engine stopping and operation at all ratings.

Fuel pressure at the unit outlet varies depending on the operating conditions.

Constant pressure valve 41 designed to throttle the inlet fuel maintains $10 \pm 1 \text{ kg/cm}^2$ pressure at the unit inlet thus eliminating the effect of fuel pressure variations on the governor characteristics. With increase of fuel pressure below the valve, the force acting on the valve increases, too. The valve spring tension appears to be inadequate to keep the valve in balance. The valve displaces and closes with its edge inlet hole I until fuel pressure decreases to the value preset by the spring tension. The pressure behind the valve decreasing, the process is reversed. Hole I area widens and, consequently, the pressure is raised to the required value.

The wobble plate tilt controls fuel flow to the engine.

The system automatic devices act on the wobble plate through a common servomechanism. This mechanism may be influenced upon by one device at a time, all other devices being switched off automatically.

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The ratings preset by the pilot are maintained through the following units:

1. Within the range of ratings from low speed to beginning of automatic operation, i.e., within manual control range, by throttle valve 35 and valve 25 (the latter maintains constant pressure drop through its passage).
2. Within the ranges from beginning of automatic operation to maximum r.p.m., i.e., within automatic control range, by variable speed centrifugal governor and weights 92. The moment the centrifugal governor starts operating marks the beginning of automatic operation.

Manual Control Range

The engine is operated with one common control lever 34. By means of a gear train the control lever shaft moves throttle valve 35 and rack 29. The latter adjusts the tension of the centrifugal governor spring 76. However, within the manual control sector the rack displacement fails to change the tension of spring 76 due to clearance "b" existing between rack 29 and guide of spring 31. Consequently, within the manual control range, the governor is adjusted for constant r.p.m. characteristic of beginning of automatic operation, i.e., above the engine actual speed, and the governor, therefore, remains inoperative.

A special valve maintaining constant pressure drop through the unit throttle valve controls fuel delivery within the manual range of operation. From the left the slide valve of constant pressure drop valve 25 is acted upon by fuel pressure at the throttle valve inlet; pressure behind the throttle valve and the spring force act on the slide valve from the right.

Spring tension determines the pressure drop at which the slide valve starts shifting. In event the pressure drop in the throttle valve exceeds the preset value the slide valve will move to the right and will allow fuel flow from inter-piston chamber 97 via duct 24, as well as supply of high pressure fuel via duct 22 under the piston of the wobble plate. This will cause the piston to shift to the right and to decrease the wobble plate tilt angle.

As a result the fuel pump output capacity diminishes, the pressure drop within the throttle valve decreases to the preset

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value. Simultaneously the slide valve overlaps the openings connected with ducts 22 and 24 to an extent ensuring pressure drop on the wobble plate piston adequate to maintain the plate in the desired position (Fig.8 shows variations in fuel pressure at the throttle valve inlet and outlet).

At engine ratings above those of the beginning of the automatic operation, the pressure drop through the throttle valve is below that preset by tension of the slide valve spring of valve 25. Under the spring action the slide valve, therefore, shifts to the left till it rests against the bushing. The slide valve collars overlap the bushing holes, thus cutting the valve from the servo-mechanism.

To provide fuel outlet from the unit when the engine is shut down with the pump rotor and engine shaft rotating for some time, return holes "a" are made in slide valve 25. They bypass fuel into the return line via duct 23 after a 15 kg/cm^2 pressure drop is obtained through the slide valve.

The pressure drop within the valve being constant, the amount of fuel fed to the engine may be changed through varying the inner diameter of the throttle valve. This is effected by displacing the throttle valve by means of control lever 34. Shifting of throttle valve 35 changes the passage area between the valve bushing guide and its shaped parts.

When the throttle valve is shifted to open, its passage area increases. Consequently, the amount of fuel pumped to the engine increases and vice versa.

At low speed the throttle valve assumes a position at which the main fuel feed through it is stopped. In this event fuel is pumped to the engine via a bypass duct and special grooves on the needle of the throttle valve. Low speed slide valve 39 and adjusting screw 38 control the fuel passage in the low speed valve. Clockwise turning of head 37 turns adjusting screw 38 in the same direction. The latter raises slide valve 39 (low speed valve) thus opening the passage in the slide valve bushing and increasing low speed r.p.m.

To decrease low speed r.p.m. head 37 should be turned counterclockwise.

The throttle valve needle is so shaped that fuel consumption at low speed (on the ground) remains practically stable while the control lever is shifted within $12 - 22^\circ$. This sector on the throttle control is called a low speed sector.

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The low speed sector is limited with two notches on the unit dial. The centre of the sector is also marked with a notch. This provides for proper operation of the engine due to elimination of possible inaccuracy in determining the low speed sector limits when setting the engine to run at low speed.

Automatic Control Range

The centrifugal governor starts operating the moment the engine gains automatic operation r.p.m. Rack 29 and hydraulic decelerator (description of this unit is given below) with further displacement of the control lever change the governor spring tension thus setting the governor at new r.p.m.

The main elements of the r.p.m. automatic governor are as follows: centrifugal transmitter with weights 92 which runs at the same speed as the pump rotor; transmitter slide valve 90, transmitter slide valve spring 76, wobble plate piston 99, return piston 96, return slide valve 86, connected through lever 81 with transmitter valve cylinder 89, and valve 41 maintaining constant fuel pressure at the governor inlet (in duct 79). (In the scheme the governor is shown in the balanced position). The force affecting the slide valve from the centrifugal governor side is counterbalanced by spring (76) force, which is determined by the position of control lever 34. In this case the collars of the transmitter slide valve of governor 90 are so positioned in relation to the holes in cylinder 89 that fuel admitted into chambers 94 and 100 under pressure maintains there constant pressure drop necessary to balance the whole system of servopistons and the wobble plate. Return slide valve 86 closes duct 79 and hole 82. Interpiston chamber 97 is disconnected from duct 79 delivering fuel via duct 87 as well as from hole 82 connected with low pressure chamber 83.

Fuel bypass determined by slide valve displacement is shown in Fig.9.

Let us consider the means of maintaining the preset r.p.m.

In case the engine speed rises due to changing flight conditions with lever 34 (See Fig.9) in fixed position, the increased centrifugal forces of weights 92 will displace slide valve 90 to the right thus letting fuel into chamber 100 under the servopiston and letting it out from chamber 94 of the return piston. As servo-

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piston 99 begins moving, the wobble plate tilt angle decreases and the delivery of fuel to the engine is reduced. The engine and fuel pump r.p.m., as well as the centrifugal forces of weights 92 will start decreasing until slide valve 90 gains its initial position and stops the movement of piston 99. Meanwhile the initial magnitude of centrifugal forces of the weights will be regained. These forces will balance the spring tension and set the engine to run at the initial r.p.m. With the r.p.m. reduced the whole process is reversed.

This mode of governor operation ensures steady adjustment of the engine speed. However, restoration of initial speed with required degree of accuracy is not provided for. It is ensured only by varying the volume of interpiston chamber 97 while the governor is in operation. Whenever deviations from the preset r.p.m. occur, both pistons 96 and 99 initially operate as a single unit, then due to the displacement of return slide valve 86 from the neutral position, interpiston chamber 97 is connected with fuel delivery duct 79 through duct 87 or via holes 82, with low pressure chamber 83.

When the speed is reduced, fuel through duct 79 flows into chamber 97 and with increased speed is let out of chamber 97. Throttling assembly 95 offers great hydraulic resistance and decelerates filling of the interpiston chamber. Therefore, further displacement of the servopiston is also decelerated.

After adjustment is completed, actuating piston 99 comes to a standstill. Meanwhile, fuel continues flowing into (or out of) the interpiston chamber. The latter circumstance brings return piston 96 into the initial position, and interpiston chamber 97 is disconnected from duct 79 and holes 82, by slide valve 86. Lever 81 connects return valve 86 with cylinder 89. Piston movement therefore brings about cylinder displacement, and when the adjustment is completed, at any position of piston 99, cylinder 89 position is always fixed.

Consequently, governor 90 transmitter valve position is fixed which ensures constant r.p.m. of the engine. While in balance, the slide valve collars must be in the neutral position relative to cylinder 89 holes.

The governor operation in the initial stage of the adjustment process ensures efficient operation of the return system (movement of the cylinder towards transmitter slide valve). At the same time

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the engine preset speed is maintained with a high degree of accuracy. When flight conditions (altitude, speed) change, the engine r.p.m. would also change but for the governor, which responds immediately to the new flight conditions by changing fuel consumption and thus maintains the preset engine r.p.m.

Controlling Engine Operation within Manual Control Range

As has already been stated, the control of fuel delivery to the engine when operating the engine within manual control range is ensured by varying the passage in the throttle valve. Within the manual engine control range, with the control lever fixed, fuel delivery is constant, while within the automatic control range the centrifugal governor maintains the preset r.p.m. irrespective of flight speed and altitude.

The above difference brings about certain peculiarities in controlling the engine r.p.m. within the manual range. With flight altitude and speed varying, different amounts of fuel are required to maintain the same speed. When the flight altitude rises or flight speed is reduced the amount of fuel required is also reduced and vice versa.

It should be borne in mind that with flight conditions varying and the lever fixed, the engine r.p.m. will change. Though manual engine control ratings (from low speed to 2800 r.p.m. of the pump shaft) are other than operating, let us consider some cases likely to occur within the manual range of engine operation.

Engine r.p.m. with the Control Lever in Low Speed Sector

With the control lever in the low speed sector fuel flow to the engine is constant irrespective of flight altitude. Hence, low speed r.p.m. increases with altitude until the r.p.m. characteristic of beginning of automatic operation is gained. Then the centrifugal governor takes over to maintain low speed r.p.m. constant up to ~ 6000 m., at which altitude the governor is switched off. The engine speed will rise until maximum r.p.m. is obtained at maximum flight altitudes. When the aircraft starts gliding with the control lever in the low speed sector, low speed

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r.p.m. will change in the reverse order.

Variation of Engine r.p.m. with Angle
of Control Lever Turn

On the ground and at low altitudes the engine r.p.m. changes almost in proportion to the control lever displacement.

As the aircraft is gaining altitude an idle travel of the lever appears due to backlash in the engine control linkage. The control lever displacing from low speed sector, the engine r.p.m. changes, until speed, characteristic of automatic control range, is attained. The speed remains stable within a certain range of control lever travel, then it again increases in proportion to the lever travel. The higher the altitude the greater is the idle travel sector. To account for its appearance, bear in mind that automatic operation r.p.m. is attained before the decelerator guiding spring touches the rack, i.e., at smaller valve opening. Part of control lever travel is, therefore, spent idle to take up clearance "b".

Controlling Engine Operation within Automatic Range

The engine speed within automatic control range is governed by changing the transmitter slide valve spring tension.

The hydraulic decelerator connects control lever 34 to transmitter spring 76 whose tension adjusts the governor for required speed.

As the control lever is shifted, rack 29 moves together with throttle valve 35.

Prior to beginning of automatic operation the rack bushing is kept away from guide of spring 31 and the transmitter spring tension remains constant. When the engine speed approaches the automatic operation r.p.m., the face of the rack bushing comes in contact with guide of spring 31. With further displacement of the control lever the guide moves together with the rack and the throttle valve. When coupling 32 closes openings "6" and stops fuel flow into the return line the hydraulic decelerator piston starts operating and actuates lever 43, thus adjusting the transmitter valve spring at a new rating.

Throttling assembly 50 connects the fuel line behind constant pressure valve 41 with the chamber left of decelerator piston 44.

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Hole "6" connects this chamber to the return line. The chamber located to the right of the piston communicates with the return line.

With the hydraulic decelerator in balance the amount of fuel entering via the throttling assembly the chamber left from piston 44 is equal to the amount of fuel flowing out through openings "6" of rod 33 and the forces acting upon piston 44 in the chambers are equilibrated.

After coupling 32 closes holes "6" fuel no longer flows into the return line. Fuel via throttling assembly 50 fills the chamber located to the left of piston 44. The piston overcoming the force of spring 45 will slowly shift towards its right side chamber. The rate of piston 44 displacement is determined by the output capacity of the throttling assembly.

When holes "6" are opened, piston 44 forced by spring 45 will energetically move to the left sending the fuel out of the chamber into the return line via holes "6".

For engine acceleration the control lever is set (at any rate) in position corresponding to maximum r.p.m. Rack 29 will then tighten spring 31, which will move coupling 32 to close holes "6". Piston 44 shifting to the right will, via lever 43, smoothly readjust the transmitter slide valve spring for a new rating. Simultaneously, the slide valve of transmitter 90 will shift from neutral and the piston of the wobble plate will assume a position ensuring increased fuel supply.

Operation of HP-10A Unit during Engine Acceleration

Fuel delivery to the engine being accelerated should be greater than that to the engine running under static operating conditions to create surplus power on the turbine shaft. However the normal engine acceleration (to be performed rapidly and without surges) requires a definite surplus of fuel to be injected to attain a desired speed.

When the control lever moves quickly from the low speed sector to the full throttle, the throttle valve opens to capacity, switching off the constant pressure drop valve. The transmitter slide valve driven by the spring to its extreme left position will change the pressure in the servomechanism cavities,

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shifting thereby the wobble plate to the maximum fuel delivery position. The pump wobble plate would have assumed this position prior to gaining maximum r.p.m. by the engine at which speed the centrifugal forces of the transmitter weights can overcome the spring force and the slide valve can change the pressure in the servomechanism towards decreased fuel delivery.

However, the engine acceleration with fuel supply at r.p.m. corresponding to the maximum tilt of the wobble plate is impossible as fuel supply under this conditions would be excessive.

To ensure fuel delivery for normal acceleration of the engine, an acceleration control unit is incorporated in the HP-10A unit.

Acceleration Control Unit Principle of Operation

The main element of the acceleration control unit is slide valve 55 which is constantly in contact with membrane 57. Fuel pressure upstream of distributing valve acts on the slide valve from the left side while the force of pressure drop between the acceleration control unit air chambers transmitted via membrane 57 and the force of spring 58 act upon the slide valve from the right. Duct 54 connects the air chamber located to the left of membrane 57, with the atmosphere. Air at p_2 pressure, created aft of the engine compressor, is forced through duct 51 into the chamber to the right from the membrane.

Slide valve 55 shifting to the right opens ducts 62 and 53 which connect cavity 100 under the wobble plate piston to the high pressure cavity behind the throttle valve. Simultaneously interposition chamber 97 connects low pressure cavity 83 (the return line, via duct 60. Movement of valve 55 changes the drop of pressure acting on piston 99 and makes it shift towards decrease of fuel consumption. The acceleration control unit becomes inoperative when the engine starts running at stable ratings. As this means the correlation of forces acting on valve 55 so affects valve 55, that it assumes the extreme left position and closes ducts 53 and 62.

While the engine is being accelerated the correlation of forces acting upon slide valve 55 is so changed that the slide valve moves to the right (the fuel pressure upstream of throttle valve increases) opens ducts 53 and 62 and controls fuel delivery

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to the engine burners through piston 99. The forces acting on valve 55 are calculated to ensure the desired rate of fuel delivery for engine acceleration. To eliminate the possibility of a sharp increase in the engine speed due to lagging in the unit operation by the end of the acceleration period, a provision is made for advanced adjustment of the governor during acceleration. This is effected with the aid of strong spring 93 (attached to return piston 96) which makes cylinder 89 of the transmitter slide valve assume a position corresponding to cutting in the governor ahead of time. Spring 93 shifts the return piston to the extreme left position, holding cylinder 89 of slide valve 90 in the same position for some time. Simultaneously the slide valve closes the cylinder holes before the engine gains the required r.p.m. thus ensuring timely operation of the governor and eliminating the possibility of surging speeds by the end of the acceleration period. As fuel pressure upstream of distributing valve 70 acts upon acceleration control unit valve 55, the fuel delivery during engine acceleration depends on distributing valve characteristic (i.e., its output capacity with regard to the upstream pressure). The valve output may be changed by adjusting tension of spring 75.

With preliminary tension increased, the valve output reduces because the valve travel and its clear opening will be smaller, the fuel pressure upstream of the valve being constant. The condition will be reversed if the spring tension is decreased. By changing the spring tension the acceleration procedure may be varied as the acceleration control valve will be set in at increased or decreased amounts of fuel flowing through the unit.

Starting Control Unit Principle of Operation

The starting control unit is designed to supply the required amount of fuel for the engine during starting. This is effected through returning the excess fuel delivered by the pump. Valve 86 starts opening and bypasses a certain amount of fuel into the return line depending on the pressure of air (p_2) bled from the compressor and let into the bypass chamber as well as on the degree of tightening of membrane spring 85. Fuel pressure upstream of distributing valve acts upon valve 86 of the starting control unit from one side. From the other side the valve is actuated by

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the efforts of the spring and the air pressure working against the membrane. As the engine speed increases air pressure on valve 68 (transmitted by membrane 66) increases as well. The quantity of fuel bypassed to the return line is decreased and, consequently, fuel delivery to the engine rises gradually.

Fuel and air pressure increase is so timed and the ratio of the valve and membrane areas is selected so as to ensure automatic control of fuel delivery in accordance with the pre-set value until low speed is attained. The starting control unit has fuel by-pass jet 67 to ensure engine starting when flying at high altitudes. Under these conditions the pressure of air delivered from the compressor decreases and valve 68 opens too wide to by-pass fuel. However, nozzle jet 67 limits this fuel flow and ensures normal starting of the engine at high altitudes. The membrane chamber communicates with the vent system.

Limit Switch

An interlocking limit switch 46 incorporated in the decelerator unit is intended to prevent switching on the afterburner until the engine is running at predetermined r.p.m. This switch keeps the afterburner control circuit open until piston 44 of the decelerator assumes a position corresponding to engine speed of 10,400-200 r.p.m.

The limit switch is adjusted to operate at pre-set r.p.m. by means of screw 49.

Minimum Pressure Valve

The minimum pressure valve keeps fuel consumption within the required limits when gaining altitude. The fuel pressure fed from fuel manifold 71 of the burners primary passages acts on slide valve 84 of the minimum pressure valve from the left side, while tension of spring 88 and return fuel pressure work against the slide valve from the right side. Fuel pressure in primary passages of the burners as well as the engine fuel consumption is controlled by spring 88 tightening. In event the fuel pressure in the primary passages of the burners exceeds the spring tension, slide valve 84 is closed. The pressure reducing, slide valve 84 shifts to the right and communicates cavity 100 under piston 99 of the wobble plate with the return line. This

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causes the shift of the wobble plate (by piston 99) towards increase of fuel delivery. Thus the minimum pressure valve controlling piston 99 determines fuel consumption pre-set by preliminary tightening of spring 88, preventing fuel consumption drop below the required limit. The minimum pressure valve maintains a constant rate of fuel consumption with altitude increasing. If stop screw 17 of minimum fuel delivery is not fitted with this valve, fuel consumption increases with altitude, thereby increasing the engine r.p.m.

IV. HP-11A UNIT. PRINCIPLE OF OPERATION

Fuel System

Fig. 10 illustrates the Key diagram of the HP-11A unit. Filter 1 is installed at the unit inlet. Fuel through the filter flows into low pressure cavity to ported member 4 of pump rotor 9 and is thence forced by the pumping unit into high pressure line 21. The plunger pump operating principle is the same as for the HP-10A unit.

With rotor 9 running plungers 11 resting against the tapered surface of thrust bearing 13 of the wobble plate reciprocate in the rotor sockets. Fuel pressure in the rotor sockets and the tension of spring 8 keep the plungers pressed against the bearing.

Fuel pressure in the plunger sockets and the plunger springs press the face of rotor 9, when the latter is running, against ported member 4. Besides, the pressure of fuel flowing from nine oblique holes in the rotor (among the plunger holes) presses the rotor to ported member 4. The ported member has 2 semicircular openings: suction opening 6 and delivery opening 7. When the plungers shift toward the wobble plate, fuel through port 6 is sucked into the cavity of the rotor below the plunger during half turn of the rotor. When the plungers during the second half turn of the rotor move backwards, fuel through opening 7 is pumped into the high pressure line. The wobble plate position, rotor r.p.m. and pressure in line 21 determine the amount of fuel supplied by the pump.

The greater is wobble plate 14 tilt, the longer is plungers 11 travel and the greater is the fuel delivery.

The servopiston, whose rod is hinged to body 14 of ball

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bearing 13, displaces the wobble plate. Servopiston 80 is governed by the barostat, which sets fuel pressure in pipe line 21 in compliance with air pressure p_1 (as determined by flight altitude and speed) in chamber 39.

Barostat

The barostat consists of two chambers, 30 and 39, divided by elastic partition 33, with double arm lever 38 fixed in its centre. Lever 38 right arm located in chamber 39 is loaded with aneroid 37 gripped between lever 38 and spring plate 36 by adjusting screw 34. Ambient air travels into chamber 39 through a gauze strainer. Lever 38 left arm located in chamber 30 is loaded with spring 28 which presses valve 27 against socket 26 through the lever.

Adjusting screw 29 ensures preliminary tightening of spring 28.

Chamber 30 is connected through a duct with the low pressure fuel line.

The balance of lever 38 and, consequently, of the barostat, depend on the tension of spring 28, pressure on valve 27 in chamber 79, pressure of eccentric rod on slide block 25 in pipe line 21, and force of aneroid 37.

Practically two magnitudes influence the system balance: fuel pressure in pipe line 21, which effects the force acting on the lever through diaphragm 24, slide block 25 and rod 32, and pressure p_1 , changing the force of aneroid 37.

When the aneroid expands freely (because of pressure drop in chamber 39) its length increases by 4.8 mm at Hg pressure drop of from 1000 to 70 mm.

Mounted in the barostat, the aneroid has very small working motion (some 0.05 mm); therefore with pressure drop in chamber 39 which corresponds to an increase of flight altitude or decrease of flight speed aneroid 37 tending to expand, exercises greater pressure on the right arm of lever 38. Spring 28 of valve 27 is thus relieved and the valve unloaded. The upper support 36 of the aneroid has a spring to prevent the aneroid from falling out of the supports at high air pressure in chamber 39 (when the aneroid is compressed) which occurs when flying at low altitudes with great speeds.

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When the aneroid is fully compressed, its upper support slides along adjusting screw 34, following the aneroid and preventing its fall-out from the supports.

Ducts via damper 77 connect servopiston cavity 79 to valve 27 of the barostat and to groove 60 of afterburner valve 59. As has already been stated, fuel from high pressure pipe line 21 is pumped to diaphragm 24 through damper 23. Fuel pressure works on block 25 and rod 32 in the eccentric bushing through the diaphragm. All this facilitates the change of arm of lever 38.

With valve 27 closed and groove 60 of the afterburner valve disconnected, jet 76 does not by-pass fuel. As this occurs, chambers 81 and 79 will be placed under equal pressures. The servopiston (acted upon by springs 78 and pressure on the area difference of piston 80) displaces wobble plate 14 to a maximum tilt, i.e., towards maximum fuel delivery. Maximum tilt of the wobble plate is adjusted by maximum delivery screw 19. When valve 27 is opened, the pressure in chamber 79 starts decreasing because fuel escapes from the chamber.

Excessive fuel pressure from chamber 81 will move piston 80 overcoming spring 78 force and displace the piston towards chamber 79.

The inclination angle of the wobble plate will be reduced with resultant decrease in fuel delivery. The piston will displace until the system is balanced, i.e. until pressure on piston 80 from the left (from the wobble plate and pressure in chamber 81) equals the pressure on the piston from the right, i.e., from the springs and pressure in chamber 79.

Thus, fuel by-pass from chamber 79 through valve 27 can be changed by controlling the pump output. The barostat adjusts pressure in pipe line 21 depending on flight altitude and speed and thus automatically controls fuel bypass from chamber 79 by adjusting the clearance between socket 26 and valve 27. During climb air pressure in the barostat chamber 39 is reduced. Aneroid 37, tending to expand, builds up an effort on lever 38 end, relieving valve spring 28. Fuel flow from servopiston chamber 79 through valve 27 increases and the servopiston shifts to decrease fuel delivery. The change in pump output will alter fuel pressure in the system before diaphragm 24. As a result a new balanced

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state will be created in the barostat and the unit will maintain reduced pressure in pipe line 21 (as compared to the ground conditions).

Aneroid characteristics, the diameter of slide block 25 (positioned on diaphragm 24) and arm length alteration (from the point where the rod of eccentric 32 touches the micrometric screw of lever 31 to elastic partition 33 at lever 38 attachment point) determine the law of pressure change in line 21 with changes in altitude and speed of flight.

Damper 23 eliminates pulsation likely to occur in fuel flowing in pipe line 21 to diaphragm 24. With the aid of screw 29 and aneroid screw 34 the barostat can be adjusted to comply with the specifications.

When afterburner valve 59 is open fuel from pipe line 21 flows into duct 74, opens cut-off valve 72, and passes, via the metering jet of fuel valve 69, to afterburner fuel nozzles manifold.

Cut-Off Valve

Cut-off valve 72 is designed to prevent fuel flow into the afterburner fuel manifold when the afterburner is inoperative. The tension of spring 64 and the extent to which fuel valve 69 covers the bushing opening determine the variation of fuel consumption in the afterburner system with the pressure in pipe line 21. As the pressure in pipe line 21 is a function of pressure P_1 , fuel consumption rate in the afterburner system (based on pressure P_1) depends on the adjustment of the barostat and the fuel valve.

Fuel Valve

The fuel valve unit installed at the pump outlet comprises a valve and a guide bushing.

The position of fuel valve 69 working edge relative to the shaped opening of the bushing determines the fuel passages in the valve unit. Displacement of valve 69 depends on fuel pressure before the valve (preset by the barostat) and tension of spring 64. As pressure before valve 69 rises, fuel passages in the bushing become wider. Initial tension of spring 64 is adjusted by screw 63.

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Controlling Afterburner Fuel Supply

Afterburner fuel supply is controlled through valve 59 linked with piston 58. Electromagnet 53 governs valve opening and closing. When the electric circuit is energized, pole 51 attracts core 52. The latter pushes rod 50 out of the pole. The rod presses on valve 49 thus closing socket 47. Fuel from duct 44 via throttling assembly 45 flows into chamber 61 and shifts piston 58 and valve 59 towards valve opening as far as compressed spring 57 permits. After current is cut off, valve 49, actuated by spring 48, opens and rod 50 returns to its initial position. Spring 57 moves piston 58 to chamber 61, and forces fuel out of the chamber into the return line through duct 46, closing afterburner valve 59.

Fuel pressure in pipe line 21 and variations in the fuel passages of the afterburner valve govern the rate of fuel delivery through the afterburner valve. The capacity of throttling assembly 45 offering a great hydraulic resistance controls the rate of afterburner valve opening.

Constant Pressure Valve

Constant pressure valve 42 is designed to maintain a constant rate of afterburner valve displacement at all altitudes. The valve maintains constant pressure in duct 44 at any fuel pressure upstream to the valve, i.e., behind filter 20. With pressure in duct 44 increasing valve 42 will shift to the left and will partially or entirely close the opening of bushing 43. The required pressure in duct 44 (preset by spring 41) will be thus ensured.

Fuel By-Pass Valve

Fuel by-pass valve 66 is designed to take off the overloads occurring when the afterburner valve is cut off. Spring 68 tightening, which determines the pressure drop in ducts 21 and 74, operates the valve. With the afterburner out, valve 66 is closed as the pressure drop through the valve is not enough to overcome the tension of spring 68. With the afterburner out, pressure in pipe line 21 will drop due to flow of fuel through valve 66 and will be determined by the tension of spring 68.

Damper 77 prevents wobble plate 14 from sharp displacement.

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Y. CONSTRUCTION OF HP-10A UNIT

The HP-10A unit comprises essentially the following parts:

- a high pressure plunger pump;
 - a variable return flow speed governor and a hydraulic decelerator;
 - a throttle valve;
 - a low speed valve;
 - an acceleration control unit;
 - a distributing valve;
 - a constant pressure drop valve;
 - a constant pressure valve;
 - a constant pressure valve, and an interlocking unit switch.
- Figs 11 - 21, 33 and 34 show the construction of unit parts and their arrangement.

High Pressure Pump

The high pressure pump consists of the following main parts: a body, a rotor, a rotor slide valve servopiston, a wobble plate with a radial-thrust bearing.

Pump body 1 (Fig.11) is cast of aluminium alloy.

Rotor 10 is manufactured of low carbon, chrome-nickel steel with subsequent case-hardening and hardening.

It rotates in roller bearing 63 and copper-graphite bearing 48.

The roller bearing is installed in pump cover 64, the copper-graphite bearing - in the pump body.

The rotor is driven from the engine through steel shaft 61 splined at both ends.

Seven holes, bored in the rotor at 15° angle to the rotor axis, are spaced evenly along its circumference. Bushings 6 of antimony bronze are pressed into the holes with a 0.04-0.06 mm negative allowance.

Steel plungers 5 with guides 8 mounting springs 7 are located in bushings 6.

The plunger cylindrical surfaces are finished accurately within ± 0.01 mm, the bushing holes, within ± 0.01 mm.

The plungers for the bushings are selected to fit with a 0.015 - 0.022-mm clearance.

The rotor central duct is splined to connect the rotor to

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the drive shaft. Steel lock ring 55 prevents the shaft from axial displacement.

To connect the rotor to the shaft of the governor transmitter splined bushing 49 is pressed into the rotor central duct with a 0.015-0.034 mm negative allowance.

The bushing is locked with 3 dowels. A rubber ring placed in the bushing groove prevents possible fuel leakage into the bushing seat. Plug 50 soldered into bushing 49 separates the inner fuel cavity of the rotor from the engine accessory wheelcase.

The rotor end face carefully machined and ground accurate within ± 0.01 mm, rests against rotor ported member 12 of antimony bronze.

Ported member 12 is fixed in the pump body by dowel 13 and lock 11. The ported member has two semicircular ports and a central opening. The pump body is provided with respective semicircular milled grooves. The lower port and central opening communicate with the low pressure chamber inlet, while the upper port connects the high pressure line outlet.

Springs 7 hold the spherical surfaces of the plungers against the tapered surface of thrust bearing moving cage.

The bearing unit consists of steel housing 57 with a fixed cage fitted in the housing with a 0 - 0.03 mm clearance. The surface of the bearing movable cage is tapered to 150°.

Bearing housing 57 carries an eye to connect the housing to servopiston rod 14 through link 2 and two holes to receive pins 65 (Fig.12), which are the bearing unit axis of rotation relative to the pump vertical axis. Adjusting steel washers 68 provide for a 0.05-0.15 mm clearance between the pump body and bearing housing; they also ensure the bearing installation in line with the pump axis. Flat steel covers 66 rest against pins 65 selected to fit the holes in the pump and rotor body with a 0 - 0.019 mm clearance. The covers are mounted on studs and secured with nuts. Rubber rings 67 and a textolite gasket ensure the seal airtightness.

Screw 52 (See Fig.11) in the pump body boss limits the maximum angle of turn of the bearing housing. Screw 58 fitted in the body cover limits the minimum angle of bearing turn. Both screws are locked by nuts 53 and covered by caps 51.

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Sealing is provided with rubber ring 54.

Pump cover 64, of aluminium alloy, covers the pump body accommodating the rotor body and bearing housing.

Three rubber glands 62 provided with springs and mounted in housing 60 seal the rotor shank. Placed between the second and third glands (counting from the gland housing parting face) is ring 59 with outer groove and holes to drain fuel in case it leaks through the first two glands. Fuel from ring 59 is routed into the engine drainage line via a system of ducts in the pump body and cover. Six screws fasten gland housing 60 to pump cover 64.

The pump cover has a fitting collar and eight holes for the studs to fasten the pump to the engine accessory wheelbase. The other side of the flange secures the cover to the pump body flange by four bolts, two of which are centring bolts. The pump body-to-cover joint is sealed with a paronite gasket. A gasket of flexible textolite seals the joint between the cover and the gland housing.

Cover 69 (Fig.13) covers the flange of the pump fuel inlet duct boss. When the pump is mounted on the engine the fuel inlet duct is attached to the flange instead of cover 69. The inlet duct-to-flange joint is sealed with rubber rings 70 and 71.

Filter 73 is installed in the low pressure cavity immediately behind the inlet duct. The filter is manufactured of brass gauze with brass fittings. The filter gauze has 1480 meshes per 1 sq.cm. The filter rests with its shoulder upon steel lock ring 72 installed in the groove of the pump body.

Variable Speed Governor

The variable speed governor comprises a centrifugal transmitter, a transmitter slide valve unit, a return slide valve and a return slide valve lever.

The construction of the speed governor and arrangement of its parts and units are shown in Fig.11.

The governor body 21 is cast of aluminium alloy and fastened with nine studs to the pump body. A paronite gasket seals the parting faces.

A rubber ring provides additional sealing for the joint of the high pressure duct.

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The centrifugal transmitter consists of fork 43 housing two centrifugal weights 39 on pins. Two ball bearings 42 (No.24), pressed into the fork, support the pin of each weight. This construction allows the weights to deviate to a certain angle under the action of centrifugal forces arising when the transmitter is rotating. Special dowels 41, pressed into the fork, limit the outward deviation of the weights when the engine r.p.m. increases. The fork rotates in two radial ball bearings 45 (No.36203E) located in a precisely machined groove in the pump body.

Steel stop ring 44 locks the bearings in the pump body. The inner cages of the bearings are tightened on the cylindrical trunnion of the fork with nut 46 which in its turn is secured with a special lock.

The pump rotor, through shaft 47 having two slit ends, drives the transmitter. One of the shaft splined ends mates with the rotor splined bushing, while the other is in mesh with splines in the central duct of the weights fork. The shaft is held in the fork against axial displacement with a dowel. The inward deviation of the weights (with the r.p.m. decreasing) is limited by the projecting cylindrical end of the shaft.

The transmitter rotates in the governor cavity which is connected through holes with a low pressure cavity (suction pressure) in the pump body. Two needles 40, whose ends are spherically machined and polished, transmit pressure from the weights to the transmitter slide valve.

The transmitter slide valve unit consists of slide valve 38, installed in slide valve sleeve 37, which moves in bushing 36 pressed with a 0.03 - 0.05 mm negative allowance in the governor body.

A 0.010 - 0.014 mm diametral clearance is observed along the end collars when attaching the slide valve to the sleeve. For two medium collars of the slide valve this clearance is decreased by 0.002 - 0.005 mm. A 0.010 - 0.014 mm clearance is observed between the sleeve and the bushing. The mating surfaces should be finished accurate within ± 0.010 . Slide valve 38 has a guide projection fitting into the recess of the fork of weights 43 which make the valve and the fork rotate with equal speed.

Two medium out-off collars of the slide valve are designed to distribute fuel among the cavities of the servomechanism pistons.

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In the face of the slide valve central duct a hole is eccentrically drilled to receive rest (24) guide and the rest itself with a spherical central groove supporting the spherical end of support needle 25. The ring of thrust ball bearing 27 is installed on the other end of the support needle having a fitting collar. A washer and a cotter pin secure the ball bearing axially.

Spring 28 acts upon the supporting needle of the transmitter slide valve.

One end of the spring is installed on a seat resting upon the thrust bearing ring, the other end rests on the fitting collar of slide 31 seated freely on pin 30 of bracket 136 (See Fig.18). The hydraulic decelerator adjusts the transmitter spring 28 for rated r.p.m.

The free end of the transmitter slide valve sleeve has a thicker part in which a cylindrical fitting collar is bored. Normal to the sleeve axis a hole is drilled to receive the spherical pin of return slide valve.

Spring 26, resting with one end on a cylindrical groove of the sleeve and with the other end on bracket 32 cylindrical groove, acts on sleeve 37 of transmitter slide valve 38. Bracket 32 also supports return lever axle 33. Bushing 36 allows for only axial displacement of slide valve sleeve 37. Return lever 33, with its spherical pin 34 resting in the sleeve hole, displaces the sleeve. Fuel is supplied to the transmitter slide valve and routed into the cavities of the servomechanism pistons or to the return line via circular grooves and holes made in the sleeve outer surface. Bushing 36 has holes through which fuel is fed to servomechanism chambers via ducts in the bodies of the pump and the governor.

Return lever unit consists of lever 33 rocking on a pin. Eccentric spherical pin 34 is inserted into the hole perpendicular to the lever axis of rocking. The spherical pin is installed and locked when balancing the governor. Splined washer 35, whose splines enter respective splines on the face part of the return lever, is mounted and locked on the threaded portion of the pin. A hole on the other end of the return lever receives fork 23. The cylindrical part of the fork groove is flattened to provide for a 0.05 - 0.2 mm axial play of the fork on the lever.

On the units issued after April 1956, instead of flattening

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the fork is locked, in the same way as the pin connecting the shackle to housing of the wobble plate bearing.

Steel return slide valve 20 travels in steel bushing 19 pressed in the governor body with a 0.03 - 0.05 mm negative allowance. A 0.01 - 0.015 mm diametral clearance is observed when joining the slide valve to the bushing. The contacting surfaces should be carefully finished accurate within at least 0.001 mm. The slide valve has a cylindrical groove with two out-off edges. The free end of the slide valve mounts stop 22, locked with a nut.

The stop, resting against the face of bushing 19, limits slide valve travel to the right. The spherical ends of fork 23 of the return lever enclose the stop cylindrical groove.

Bushing 19 of the return slide valve has three holes: the right connects with the duct downstream from the constant pressure valve; the middle one, connected through the throttling assembly (Fig.14) with the interpiston area, and the left one connected with the low pressure cavity.

When assembling the unit, the governor is balanced in the following way: the weights of the transmitter and return slide valve are set in the neutral position, dimensions "a" and "b" (Fig.11) are maintained by a clearance gauge; then the eccentric spherical pin is turned till the transmitter slide valve out-off edges and the holes in the slide valve sleeve are so arranged as to ensure equal pressure under return piston 156 and piston 15a of the wobble plate.

The pressure difference must not exceed 0.8 kg/cm^2 (the test is carried out on a special stand). Then the splined washer 35 is nutted up. Steel bushing 17, pressed in the governor body with a 0.04 - 0.06 mm negative allowance, houses the servomechanism consisting of two pistons 15a and 156 which travel in the bushing.

The bushing fits into the pump body with a clearance and is sealed along the face with a rubber ring. The rubber pistons are reinforced with steel discs. Rod 14 of the wobble plate piston mounts the right piston; return slide valve 20 mounts the left piston. Both pistons are secured with nuts fitted with steel locks. The joints are tightened with rubber rings. Rod 14 of the wobble plate piston travels inside the bronze bushing pressed in pump body 1. Link 2 connects the eye of bearing housing 37

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of the wobble plate and rod 14. One end of the link is fitted on the slide block freely seated on pin 4 of rod 14 (the pin ends are rolled out). The other end of link 2 is attached to pin 3 secured with a lock.

Located in the interpiston area is spring 16, which actuates piston rod 14 and brings the wobble plate to the stop of maximum fuel delivery before starting the engine.

Governor Throttling Assembly

The throttling assembly (See Fig.14) is designed to ensure the required rate of governor servomechanism operation. It comprises a steel threaded body 74, housing a set of flat jets 77 separated with washers 78.

To increase resistance to fuel flow, the orifices of some jets are displaced relative to one another. To protect the jets from clogging two screens (frame screen 75 and fine mesh screen 76), are soldered to the assembly body. Two flat screen filters 79 manufactured of brass screen No.015 (similar to the screen of the inlet filter) are installed inside the assembly body. A set of jets with washers and filters is held tightly with nut 81 through distance piece 80 in the throttling assembly body. The throttling assembly flow rate is checked on a test stand and is adjusted to be within 100 - 180 cu.cm/min. at 10 kg/cm² pressure upstream to the assembly.

The throttling assembly is installed into the governor body and tightened with a threaded plug (Fig.13). Circular rubber rings 82 ensure proper sealing of the assembly (Fig.14). Fuel (via return slide valve) is fed from the constant pressure valve into the area under the plug (upstream to the throttling assembly). Ducts connect the area downstream from the throttling assembly to the interpiston cavity (hydraulic damper) of the servomechanism and the constant pressure drop valve.

Throttle Valve with Control Mechanism

The throttle valve (Fig.15) consists of metering needle 83 and bushing 84. Needle 83 is manufactured of bronze and has a through central hole to relieve the needle of fuel pressure. One end of the needle has 4 through triangular milled grooves and a variable cross section.

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Each segment formed by these profiles has a triangular blind milled groove and a variable cross section. The through hole at the other end of the needle is threaded to receive a stud to facilitate the needle installation and removal. One side of the needle cylindrical surface has a flat and carries an integral rack (0.75 modulus) to engage the gear of control shaft 94.

Steel bushing 84 (needle seat) (See Fig.15) has a central metering orifice to receive the needle with a 0.010 - 0.015 mm clearance and six holes, 8 mm in dia. spaced along the circumference to deliver fuel to the metering needle. Four 3 mm holes are designed to supply fuel when operating at low speed. Bushing 84 is pressed into the governor body right home with a 0.03 - 0.04 mm diametral negative allowance. Threaded bushing 91 is screwed into the groove of the throttle valve. Pipe union 93 is screwed into bushing 91 to clamp the turn nipple 92 which is employed to measure fuel pressure downstream from the throttle valve. A rubber ring seals the joint between threaded bushing 91 and governor body 21.

The control mechanism (Fig.16) consists of control shaft 94, shaft bushing 95, limiter 100, adjusting eccentric 102, and control lever 101. Shaft bushing 95 is manufactured of steel integral with the flange. It is a slide fit in the governor body and is secured with 3 dowels to the flange of governor body. A rubber ring seals the joint between bushing 95 and the flange. The shaft bushing supports the control shaft. Bronze bushing 97 pressed in the groove of governor body provides another support for the shaft.

The control shaft carries two integral gears. The gear with the larger diameter ($m = 0.75$, $z = 25$) is designed to mesh with throttle needle 83 (See Fig.15); the gear with the smaller dia. ($m = 0.75$; $z = 12$) meshes with rack 96.

Two rubber rings ensure the sealing between the control shaft and the control shaft bushing. The part of the control shaft projecting from the governor body is machined to two diameters: triangular splines are cut on the surface of the larger diameter shaft; the smaller dia. surface is threaded and provided with a hole to receive a split pin. Limiter 100 is installed on the shaft splines so that its lug faces sector 99 fastened to the governor

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body with two studs. The studs secure bushing 95 to the throttle valve shaft. The tapered surface of the limiter carries adjusting eccentric 102 and a washer secured with a castellated nut. The outer diameter of adjusting eccentric 102, made eccentrically to the shaft mounting hole has teeth ($m = 1$, $z = 25$) for the control lever to be installed at a required angle of turn. The lever is bolted on the adjusting eccentric. When the control lever is turned the limiter lug thrusts against screws 98 in the governor body bosses thus limiting the angle of turn of the control lever.

Constant Pressure Drop Valve

The valve unit (Fig.17) consists of steel valve plunger 103 travelling in steel bushing 104 which is pressed in governor body 21 with a 0.03 - 0.04 mm negative allowance. A 0.007 - 0.009 mm diametrical clearance is observed when coupling the slide valve to the bushing. The contacting surfaces are machined accurate within at least ± 0.001 mm.

Bushing 104 has on its outer diameter 3 grooves communicating through the governor body with the following parts of the unit: the right groove connects with the servomechanism inter-piston cavity (hydraulic damper); the medium one - with the return line; the left groove - with the cavity over the piston of the pump wobble plate rod. Each groove connects with the bushing inner cylinder via two holes.

The right edge of the groove in the valve plunger is a spill edge. The edge of the valve plunger face serves as a second spill edge.

Inside the valve plunger there is a blind short central duct which connects with six holes drilled in the slide valve surface. Through the holes fuel is by-passed from the cavity over the piston rod of the wobble plate to the return line.

Spring 105 acts upon the shoulder of the slide valve and rests with the second end against the bottom of plug 106, screwed into the governor body. Spring 105 tension is adjusted by washer 107. The spring interior is connected with the cavity behind the throttle valve. High pressure is fed to the face of the slide valve after the pump, i.e. upstream of the throttle valve.

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As the pressure drop within the throttle valve exceeds the value set by the spring tension, the valve plunger will move so that its right edge will connect the inter-piston chamber with the return line. Simultaneously, the cavity under the piston of the wobble plate rod connects with the high pressure line. As a result, the piston will move the washer to decrease fuel delivery and, consequently, the pressure drop on the throttle valve will be brought to the preset value.

Constant Pressure Valve

The constant pressure valve unit (Fig.18) includes slide valve 108, travelling in steel bushing 109. The latter is pressed into the governor body with a 0.03 - 0.05 mm negative allowance. A 0.010 - 0.014 mm diametrical clearance is observed when inserting the slide valve into the bushing. The contacting surfaces are finished accurate within at least ± 0.001 mm. The slide valve is provided with a central duct and a through boring, 0.5 mm in dia. which communicates the high pressure cavity with the low pressure cavity. The central duct is connected via four holes with the groove on the slide valve. The lower edge of the groove is a spill edge. The slide valve outer cylinder has 5 relieving slots (in addition to the groove).

A cylindrical groove on bushing 109 outer surface receives fuel from the high pressure cavity. Six holes connect the boring with the bushing inner surface.

Slide valve shoulder is acted upon by spring 105, whose other face rests on the bottom of plug 110 screwed into the governor body. The spring tension is adjusted by washers 107. The spring interior communicates with the inlet fuel under pressure.

The constant pressure valve maintains constant pressure of fuel fed to the transmitter slide valve, controlling its flow from the high pressure cavity.

Hydraulic Decelerator

The hydraulic decelerator (See Fig.19), located in the governor and fuel distributor bodies, tightens the transmitter spring, which sets the governor to the required r.p.m. The hydraulic decelerator consists of the following main parts and units: a rod piston, a decelerator, a lever, a clutch, springs,

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a bushing and a throttling assembly.

The construction of piston 124 is similar to that of the servomechanism (described above). Piston 124 travels inside steel chrome-plated bushing 123, pressed into the distributor body with a 0.04 - 0.07 mm negative allowance.

Spring 125 acts on piston 124. The other end of the spring rests against the groove in the middle body of electric switch 127. Piston 124 divides the bushing of hydraulic decelerator into two chambers. The chamber to the left from the piston is intended for fuel, the right one houses the spring.

The spring chamber of the hydraulic decelerator connects with fuel pressure chamber at the unit inlet via a duct. The throttling assembly (See Fig.14) connects the fuel chamber with the cavity behind the constant pressure valve.

The throttling assembly flow rate is 30 - 80 cu.cm. of fuel per minute. Its construction is similar to that of the servomechanism (described above).

The hydraulic decelerator rod 119 travels with a 0.01 - 0.015 mm clearance in bronze bushing 122 pressed into the governor body with a 0.03 - 0.05 mm negative allowance. Special nut 135 encloses the groove of electric switch rod 134 and secures the piston on the rod of the hydraulic decelerator. Adjusting screw 129 secured in cover 132 of the interlocking device switch serves as the engine maximum r.p.m. stop.

From the piston side rod 119 has a central duct with two holes drilled to connect with the rod periphery. One hole connects with the fuel chamber, the other one opens on the rod surface (section of coupling 118 travel).

The rod of the hydraulic decelerator mounts coupling 118 with a 0.005 - 0.008 mm clearance. Spring retainer 116 is rolled in the spherical surface of the coupling. Spring 117 tends to move coupling 118 to the left while a spring lock limits the coupling travel. Two studs fasten bracket 136 to the governor body surface. Pin 30 is pressed home in bracket 136. Slide block 31 mounted on the pin with a 0.01 - 0.02 mm clearance has a cylindrical groove, receiving the spherical end of slide valve lever 137. The slide valve shoulder supports transmitter spring 32.

The body, of steel, has a flat fitted with teeth (0.75 mm - 0.8 mm outer diameter).

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Inside the rack there is a staged groove, whose smaller diameter is threaded to receive bushing 115. The bronze bushing, housing rack 96, is pressed into the governor body with a 0.04 - 0.07 mm negative allowance. A threaded hole in the governor body receives sleeve 113 of adjusting stop 114. The teeth of the rack are in mesh with the teeth of control shaft 94 (See Fig.16). The slots of threaded bushing 115 receive the dowels of adjusting stop 114. With the aid of stop 114 the transmitter spring tension can be adjusted to start the governor automatic operation at 3040₋₆₀ r.p.m.

By turning the control lever the throttle needle is set to by-pass the amount of fuel required for the beginning of the governor automatic operation. Threaded bushing 115 is then screwed in as far as retainer 116 permits. In this position the adjusting screw is locked with a nut and fitted with cap nut 112.

During engine acceleration control lever 101 (See Fig.16) can be shifted with arbitrary speed to the maximum r.p.m. stop or to any other intermediate stop. Rack 96 will then move coupling 118, close the hole on the rod and tighten spring 117. Fuel flow from the hydraulic decelerator fuel chamber will cease and piston 124, forced by fuel coming under it will shift slowly. As this occurs lever 137 of the slide valve will smoothly tighten the spring of transmitter 28 slide valve thus ensuring engine operation at a new rating. Piston 124 will shift until the coupling edge closes the hole in the rod.

The transmitter of the slide valve acted upon by spring 28 shifts to the left from neutral position; piston 13a (See Fig.11) of the wobble plate moves towards increase of fuel delivery.

Low Throttle Valve

The low throttle valve is incorporated in the governor body. It is of slide valve type (See Fig.15).

Pressed into governor body 21 with a 0.02 - 0.04 mm negative allowance is steel bushing 85 with a rectangular through slit covering a portion of the generating line. The slit provides for fuel flow from the by-pass channel of the throttle valve. Cylindrical steel slide valve 83 travels inside steel bushing 85, with a 0.010 - 0.014 mm clearance. A blind threaded groove in the valve face receives screw 87.

Turning of adjusting cap 89 sets the valve at fuel economy.

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a bushing and a throttling assembly.

The construction of piston 124 is similar to that of the servomechanism (described above). Piston 124 travels inside steel chrome-plated bushing 123, pressed into the distributor body with a 0.04 - 0.07 mm negative allowance.

Spring 125 acts on piston 124. The other end of the spring rests against the groove in the middle body of electric switch 127. Piston 124 divides the bushing of hydraulic decelerator into two chambers. The chamber to the left from the piston is intended for fuel, the right one houses the spring.

The spring chamber of the hydraulic decelerator connects with fuel pressure chamber at the unit inlet via a duct. The throttling assembly (See Fig.14) connects the fuel chamber with the cavity behind the constant pressure valve.

The throttling assembly flow rate is 30 - 80 cu.cm. of fuel per minute. Its construction is similar to that of the servomechanism (described above).

The hydraulic decelerator rod 119 travels with a 0.01 - 0.015 mm clearance in bronze bushing 122 pressed into the governor body with a 0.03 - 0.05 mm negative allowance. Special nut 135 encloses the groove of electric switch rod 134 and secures the piston on the rod of the hydraulic decelerator. Adjusting screw 129 secured in cover 132 of the interlocking device switch serves as the engine maximum r.p.m. stop.

From the piston side rod 119 has a central duct with two holes drilled to connect with the rod periphery. One hole connects with the fuel chamber, the other one opens on the rod surface (section of coupling 118 travel).

The rod of the hydraulic decelerator mounts coupling 118 with a 0.006 - 0.008 mm clearance. Spring retainer 116 is rolled in the spherical surface of the coupling. Spring 117 tends to move coupling 118 to the left while a spring lock limits the coupling travel. Two studs fasten bracket 136 to the governor body surface. Pin 30 is pressed home in bracket 136. Slide block 31 mounted on the pin with a 0.01 - 0.02 mm clearance has a cylindrical groove, receiving the spherical end of slide valve lever 137. The slide valve shoulder supports transmitter spring 28.

The rack, of steel, has a flat fitted with teeth (0.75 modulus) along its outer diameter.

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Inside the rack there is a staged groove, whose smaller diameter is threaded to receive bushing 115. The bronze bushing, housing rack 96, is pressed into the governor body with a 0.04 - 0.07 mm negative allowance. A threaded hole in the governor body receives sleeve 113 of adjusting stop 114. The teeth of the rack are in mesh with the teeth of control shaft 94 (See Fig.16). The slots of threaded bushing 115 receive the dowels of adjusting stop 114. With the aid of stop 114 the transmitter spring tension can be adjusted to start the governor automatic operation at 3040 - 60 r.p.m.

By turning the control lever the throttle needle is set to by-pass the amount of fuel required for the beginning of the governor automatic operation. Threaded bushing 115 is then screwed in as far as retainer 116 permits. In this position the adjusting screw is locked with a nut and fitted with cap nut 112.

During engine acceleration control lever 101 (See Fig.16) can be shifted with arbitrary speed to the maximum r.p.m. stop or to any other intermediate stop. Rack 96 will then move coupling 118, close the hole on the rod and tighten spring 117. Fuel flow from the hydraulic decelerator fuel chamber will cease and piston 124, forced by fuel coming under it will shift slowly. As this occurs lever 137 of the slide valve will smoothly tighten the spring of transmitter 28 slide valve thus ensuring engine operation at a new rating. Piston 124 will shift until the coupling edge closes the hole in the rod.

The transmitter of the slide valve acted upon by spring 23 shifts to the left from neutral position; piston 13a (See Fig.11) of the wobble plate moves towards increase of fuel delivery.

Low Throttle Valve

The low throttle valve is incorporated in the governor body. It is of slide valve type (See Fig.15).

Pressed into governor body 21 with a 0.02 - 0.04 mm negative allowance is steel bushing 35 with a rectangular through slit covering a section of the generating line. The slit provides for fuel flow from the by-pass channel of the throttle valve. Cylindrical steel slide valve 36 travels inside steel bushing 35, with a 0.010 - 0.014 mm clearance. A blind threaded groove in the valve face receives screw 37.

Turning of adjusting stop 39 sets the valve at fuel delivery.

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tion required to maintain low speed r.p.m. When adjusting cap 90 is being turned, pin 88 coupled through the slot with screw 87 shifts valve 86, thus increasing or decreasing the clear opening of the slit in bushing 85.

Distributing Valve

The distributing valve unit (Fig.19) comprises the following parts:

- plunger 143;
- bushing 144,
- spring 141,
- spring seats 140 and adjusting screw 138.

Thirteen studs secure the distributing valve unit installed in the distributor housing to the governor body, the joint being sealed with a paronite gasket; besides, the joint of the main fuel high pressure duct is sealed with a rubber ring. Bushing 144 of the distributing valve is manufactured of steel; its central hole is finished accurate within ± 0.011 . The bushing face has cylindrical grooves. Machined on two spots of the bushing outer surface are four flats (two parallel flats per spot) provided with through slits.

The triangular slits are designed to let fuel into the burners primary manifold, while rectangular slits let fuel into the burners secondary manifold.

A staged well is bored in the distributor housing. The smaller diameter well hole houses bushing 144 with a $0.006 - 0.037$ mm clearance. To seal the bushing, rubber rings are placed under its face and in the two cylindrical grooves.

Plunger 143 of the distributing valve is manufactured of bronze, carefully finished on its outer diameter and selected to fit bushing 144 with a $0.010 - 0.014$ mm diametrical clearance. A long cylindrical groove on the slide valve outer diameter forms the operating out-off edge. Seven holes connect the inner duct of the plunger with the annular cavity formed by the groove. The edge of the slide valve face serves as the second out-off edge.

Sleeve 142 is installed in the larger diameter section of the well in the distributor housing with a $0.03 - 0.15$ mm clearance. The face of the plunger bushing supports the sleeve face. Several holes in the sleeve drain the fuel that has penetrated

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through the plunger valve.

Four studs secure cover 139 to the distributor housing. Its fitting collar is pressed against sleeve 142, transmitting axial loads on the lower rubber ring. A rubber ring seals the joint between the cover and the distributor housing. The threaded hole on the cover receives screw 138, which serves to tighten spring 141 to a definite pressure to open the plunger after adjusting screw 138 is secured with a nut. Cap 51 is screwed on the free end of the screw.

With fuel pressure before distributing valve increasing, plunger 143 overcomes the tension of spring 141 and shifts until a 4 ± 1 kg/cm² pressure is reached; the working edge on the slide valve cylindrical groove opens the triangular slits. Fuel via plunger inner ducts and open slits flows into the burners primary manifold through pipe union 145. With fuel pressure upstream to the distributing valve increasing to 8.5 ± 1 kg/cm² the working edge of the plunger face opens the rectangular slits and fuel via pipe union 146 will be forced into the burners secondary manifold through pipe union 146.

Acceleration Control Unit

The acceleration control unit installed in distributor body 121 (Fig.19) comprises valve 148 travelling with a $0.010 - 0.012$ mm clearance inside bushing 147 pressed into the distributor housing with a $0.03 - 0.05$ mm negative allowance. The stop of membrane 149 unit supports slide valve 148 head. From one side the valve is acted upon by fuel pressure (upstream of the distributing valve) while the membrane works against the valve on the other side.

From one side the membrane experiences the pressure of the atmospheric air, while from the other it is acted upon by the air from the engine compressor and by the pressure of spring 150. The spring tension is adjusted through screw 151.

The membrane, of rubberized fabric, is secured between two steel discs with 6 rivets, spaced along the discs circumference. One of the discs rests against the face of valve 148 with a central cap. A circular shoulder provided on the other disc aligns spring 150 which rests on the disc.

Bushing 147 has a supporting shoulder and four rows of

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radial holes. The first row (adjacent to the shoulder) with four oblique holes is designed to route the seeping fuel into the vent line. The second row having two holes is designed to by-pass fuel from the interpiston cavity of the servomechanism through a wide groove on the valve and the third row of holes in the bushing. The fourth row of holes by-passes fuel at high pressure under the actuating servopiston to reduce the angle of tilt of the thrust-radial bearing.

Starting Control Unit

The starting control unit installed in the distributor body (Fig.19) comprises the following main parts:

- a valve socket;
- a valve;
- a rod, a rod guide;
- a membrane;
- a jet nozzle, and an adjusting screw of the spring.

The steel seat 159 of the fuel valve is screwed into the distributor body. The circular polished shoulder of the valve seat supports valve 157, which consists of a steel base and a washer made of rubber No.4327 welded to it. The tapered recess of the valve base receives steel rod 156, travelling in bronze guide 155 with a 0.008 - 0.011 mm clearance.

The stop of membrane 149 unit supports the other end of rod 156.

Fuel pressure (upstream to distributing valve) acts on valve 157 from one side. Membrane 149 (which takes up the pressure drop between the atmospheric and the compressed air pressures) and spring 154 work from the other side of the valve. The spring can be tightened by adjusting screw 151.

The duct delivering fuel to the starting control unit is fitted with a jet by-passing the excessive fuel delivered by the pump to the return line.

Minimum Pressure Valve

The minimum pressure valve (Fig.20) unit located in the distributor body 121 comprises the following main parts: steel bushing 163, pressed with a 0.03 - 0.04 mm negative allowance, steel valve 162, travelling inside the bushing with a 0.008 -

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0.010 mm clearance, stop 160 and spring 161. Bushing 163 has a groove on its outer diameter. The pressed surface of the bushing has eight holes, 2.2 mm dia., which communicate via ducts with the cavity located over the actuating servopiston of the wobble plate. Four holes, 5 mm in dia., drain the fuel into the low pressure line.

The tapered surface decreasing towards the wide circular groove on valve 162 acts as a working surface. In case fuel pressure, acting on valve 162 face, exceeds the preset value the valve head will press stop 160. With fuel pressure decreasing below the specified value, valve 162 acted upon by spring 161 will shift and its working tapered surface will open in the bushing a 2.2 mm dia. hole. Thus the cavity above the actuating servopiston 156 will be connected with the return line (See Fig.11). This will make piston 156 shift the wobble plate towards increase of fuel delivery.

Interlocking Device Switch

The interlocking device electric switch (See Fig.18) is installed on the housing of the fuel distributor and comprises the following main parts and units: a switch housing, a rod, a plug, an adjusting screw with a fork, a cover, a lever, and a spring. Switch housing 127 is an aluminium casting. Bronze bushing 133, inside which rod 134 travels with a 0.010 - 0.014 mm clearance is pressed in the central recess of the housing with a 0.02 - 0.04 mm negative allowance.

Switch 126 (KB-6) is installed in the switch housing pocket. Four screws secure the plug to the switch housing recess. Four studs and a centring collar ensure correct positioning of the switch housing on the distributor housing. The same studs fasten to the switch housing cover 132 with maximum r.p.m. adjusting screw 129 and adjusting screw 130 with fork 131 and lever 128 on the fork pin. Adjusting screw 130 serves for setting the interlocking device switch to the desired r.p.m.

Central Fine-Mesh Filter

To strain fuel fed into the variable speed governor a fine-mesh filter is incorporated in the governor body. Fig.21, A shows the filter construction. Filter body 165 is a bronze cy-

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linder provided with eight ribs. Two rows of rectangular slits "a" and "b" pass fuel between the ribs. Frame screen 167 and fine-mesh screen 168 with 0.020 - 0.035 mm meshes are soldered to the ribs. Steel studs 174 are installed between the ribs over the fine-mesh screen in the slots of body 165 for greater rigidity. The studs are held in position by two rings 173, soldered to the filter body.

The filter is fitted with safety ball type valve 166, adjusted for opening at a 0.4 - 0.6 kg/cm² pressure drop with the aid of adjusting washer 170. When the fine-mesh filter 168 becomes clogged fuel is routed through the ball type safety valve.

Since October 1956 the units are fitted with modified filters comprising 16 - 18 separate filtering discs (Fig. 21 E). The filter length must be 74.5 ± 0.5 mm which is ensured by selection of proper washers.

Air Relief Valve

Presence of air inside the unit affects the stability of the engine r.p.m. and may disturb the unit adjustment.

Ball type valve 6 (Fig. 28) releases air from the unit.

VI. CONSTRUCTION OF HP-11A UNIT

The HP-11A unit comprises the following main parts:

- a high pressure plunger pump;
 - a barostat (altitude corrector);
 - an afterburner valve with a servomechanism;
 - a fuel valve;
 - a constant pressure valve;
 - a fuel by-pass valve;
 - a cut-off valve;
 - an electromagnet switch, and an interlocking device switch.
- Figs 22 through 27, 35 and 36 show the construction of parts and units and their mutual arrangement.

High Pressure Pump

The parts of the high pressure pump (Fig. 22) are encased in a housing, cast of aluminium alloy.

Rotor 6, manufactured of low carbon chrome-nickel steel and

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case-hardened, rotates in two bearings. Cover 17 of pump rotor cavity houses roller bearing 16 (No. 292202). Pressed in pump housing 1 with a 0-0.02 mm negative allowance is another roller bearing whose fixed solid steel race 2 is held by steel lock ring 3 against axial displacement. Rollers 3 are held from axial displacement by a groove with shoulders machined on the rotor surface. Duralumin cage 4 provides for even arrangement of rollers along the circumference. The rollers are selected so that the difference in their diameters is not more than 0.002 mm. Shaft 12 splined on both ends serves to translate motion from the engine aircraft to the rotor. Pressed evenly along the rotor circumference at 15° to its axis, with a 0.04 - 0.06 mm negative allowance are sleeves 7 of antimonous bronze. The sleeves house nine steel plungers 8 with springs 10 on guides 9. The plungers cylindrical surfaces are finished accurate within ± 0.01 mm. The sleeve holes are finished accurate within ± 0.01 mm. The plungers are selected to fit the sleeves with a 0.015 - 0.022 mm clearance.

The rotor central duct is splined to mesh with the drive shaft. Steel locking ring 11 holds the shaft from axial displacement. Pressed into the rotor central duct is splined bushing 24 with a rubber packing ring and three cylindrical lock pins 25.

This bushing insulates the pressurized inner cavity of the rotor from the engine accessory drive box. Nine ducts connect the rotor inner cavity with the pump housing cavity. Due to centrifugal forces engendered by the rotor movement, fuel flows via the ducts from the rotor inner cavity inside the pump housing. Ported member 26, of antimonous bronze, provided with two semi-circular ports and a hole in the centre, is fixed by six dowels in the pump housing. Milled in the pump housing are respective semi-circular grooves to match the ports of the ported member. The lower port and central hole communicate with the low pressure cavity inlet; the upper port is connected with the high pressure pipe line outlet. The locating pin ensures correct fitting of the ported member. Springs 10 press the plungers spherical surfaces to the tapered surface of the thrust bearing movable race.

Bearing steel body 18 houses (with a 0 - 0.03 mm clearance) the fixed race of radial-thrust bearing 19. The bearing movable race surface is tapered 150°. An eye in bearing body 18 serves

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to connect the latter through a link to the wobble plate piston rod. Bearing body 18 has two holes to receive pins 20 on which the bearing rotates relative to the pump vertical axis.

Adjusting washers 23 provide for a 0.05 - 0.15 mm clearance between the pump housing and bearing body and ensure accurate fitting of the bearing along the pump central line. Pins 20, selected to fit the holes in the pump housing with a 0.019 mm clearance and those in the bearing body with a 0.006 - 0.022 mm clearance, have flat steel covers 22 which are studded and nutted. A rubber ring and textolite gasket 21 seal the pin-to-cover joints.

The piston mounted on wobble plate piston rod 48 travels in bronze bushing 49 which is pressed in the pump housing with a 0.03 - 0.06 mm negative allowance.

The piston is made of steel disc 44 fitted with rubber cup 45. Expanding plate 46 pressing the rubber cup to piston bushing 47 is installed between disc 44 and piston rod 48. A rubber ring seals the disc-to-expanding plate joint. Wobble plate piston rod 48 is connected to wobble plate bearing body eye through link 51 which is attached to a block fitted to rod pin 50 (the pin ends are flattened) and to pin 52.

The piston is actuated by springs 42 and 43 which act on piston rod 48 and bring the wobble plate to maximum fuel delivery position before engine starting.

Screw 37 in the pump housing boss limits the bearing body maximum angle of turn. Screw 53 turned in the rotor cover limits the bearing minimum angle of turn. Both screws are locked with nuts 38 and covered with caps 39. The joint is sealed with rubber rings.

The pump cavity, housing the rotor and bearing body, is provided with cover 17 made of aluminium alloy.

Three spring-loaded rubber glands 13 seal the rotor shank.

The glands are installed in housing 15. Ring 14 with outer groove and fuel drain holes is fitted between the second and third glands counting from the gland housing joint.

From ring 14 fuel via ducts in the pump cover and housing is directed into the engine drain pipe line.

Six screws fasten gland housing 15 to pump cover 17. The cover has a mounting shoulder and eight holes to receive the studs fastening the unit to the engine accessory drive gear box.

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Two bolts and two centring bolts fasten the cover flange to the pump housing flange.

A paronite gasket seals the joint between the pump housing and cover. The joint between the cover and the gland housing is sealed with a flexible textolite gasket.

The pump boss flange of the inlet duct is provided with a lid, which is removed when the fuel pump is mounted on the engine, and the fuel inlet duct is fitted instead to take in fuel. The inlet duct joint is sealed with rubber rings. Strainer 27 is installed in the low pressure cavity immediately after the inlet duct. The strainer has a brass screen and brass fittings. The strainer screen has 1480 meshes per one sq.cm. Lock ring 28 in the pump housing groove supports the strainer collar.

Barostat

The barostat comprises two housings: the housing of valve 63 and that of aneroid 54 (Fig.23), joined together by studs. The barostat is mounted on the fuel pump housing on the side of the groove which receives the servopiston guide sleeve. A rubber reinforced partition 56 fitted between the valve and aneroid housings supports double arm lever 55 fixed in the centre of the partition and serves for tightening the joint between the aneroid and valve housings. One arm of the lever projecting into the aneroid housing has a tapered recess for the installation of aneroid 76. The second arm of the lever projecting into the valve housing has a cylindrical groove to receive spherical valve 68.

Both end faces of the capsule type aneroid are provided with cones. When fitting the aneroid on the fuel pump housing one of the cones is placed into the tapered recess of the lever, the other one is centred in cover 83 by means of the cone support of spring 85.

Prior to installing the aneroid into its housing the latter is filled with 40 - 45 cm³ of a mixture of transformer oil (50%) and kerosene, grade T-1 (50%).

The aneroid is fitted on the fuel pump housing with its capillar downward as shown in Fig.23. Adjusting screw 77 in the centre of cover 83 enters the central hole of spring 85 support

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and fixes the aneroid between the supports. The upper protruding end of adjusting screw 77 is locked with nut 79 and covered with cap 78. Sealing is ensured by red copper gaskets.

Air is admitted into the aneroid chamber through gauze filter 82 which is installed in the aneroid chamber and soldered to bushing 81 of air inlet pipe union 80.

The lower portion of the aneroid housing is provided with stop screw 86 limiting the possible angle of turn of double arm lever 55. The fuel valve is screwed into housing 63 and locked in place. The valve comprises steel seat 64 fitted with jet nozzle 67 of superhard alloy having a calibrated orifice. The valve seat upper portion acts as a support for valve 68 and is machined and lapped on its collar flush with jet nozzle 67.

Valve 68 is a spherical segment of hard alloy BK6. The valve spherical surface enters freely the cylindrical groove of lever 55 which ensures full contact between the valve seat and the flat portion of the valve irrespective of the position of the lever. The clearance between the valve seat complete with the jet nozzle and valve 68 prior to fitting spring 70 and aneroid 76 should not exceed 0.03 - 0.5 mm. The clearance will be adjusted by shims 66. It is allowed to use only one shim for the purpose. After selection of a shim and upon completion of tightness check, the valve will be secured with lock 65.

Spring 70 fitted on cone guides 69 through lever 55 presses valve 68 to its seat. Spring tension is adjusted by screw 71 turned into cover 72. The upper end of adjusting screw 71, projecting outside, is locked by nut 38 and closed with cap 39. The sealing is ensured by rubber rings. Positioned between valve seat 64 and reinforced partition 56 is diaphragm body (eccentric) 57 with rod 62. The body has a flange with twelve holes evenly spaced around its circumference. The flange and cover are secured to the body with three screws. As the arm of pressure acting on lever 55 varies in length the diaphragm body turns and is fixed in a new position.

The diaphragm body-to-valve housing joint is sealed with the aid of a rubber ring.

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Pressed between cover 61 and the flange of diaphragm body is rubber diaphragm 58, which supports ring 60 and retainer block 59. Rod 62 rests against retainer block 59. The opposite end of the rod touches the cap of micrometric screw 73 turned into the lever. With valve 68 closed ring 60 must be flush with retainer block 59. This is adjusted by micrometric screw 73.

After adjustment the nut of the micrometric screw should be locked. The parts of the diaphragm body unit are lubricated with graphite oil. To preserve lubricant during operation rubber gland 74 with cap 75 is adjusted on the rod. Pulsation of fuel, delivered to diaphragm 58, is eliminated by the damper (Fig. 24).

The damper unit consists of steel sleeve 87 accommodating damper 88, which is a brass cylindrical rod with seven cylindrical grooves interconnected by 0.4 mm dia. holes. The damper unit is installed in the circular grooves of the pump body and valve housing butt faces. The joint is sealed with a rubber ring.

Afterburner Valve with Servomechanism

The afterburner valve with servomechanism (Fig. 25) comprises essentially the following main parts: the afterburner valve, the afterburner valve sleeve, the piston and its sleeve, the spring and throttling assembly. The afterburner valve unit is installed in the stepped bore of the pump body. The smaller dia. hole houses afterburner valve steel sleeve 89, pressed into the hole with a 0.03-0.04 mm negative allowance. The larger dia. hole houses, with a 0.04-0.07 mm negative allowance, piston sleeve 98, of steel, chrome-plated on its inner surface.

The afterburner valve sleeve has three rows of holes. The first row (counting from the shoulder) includes two holes, 2 mm in dia. They are connected with a duct delivering fuel from the spring chamber of the wobble plate piston servomechanism.

The second row consists of four holes, 8 mm in dia., admitting fuel from the high pressure chamber of the fuel pump.

The third row consists of four holes, 8 mm in dia., feeding fuel to the cut-off valve. On the inner diameter of the afterburner valve sleeve, opposite the 8-mm dia. holes, two wide

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cylindrical grooves are machined. The grooves are separated with a cylindrical collar, whose edge facing the high pressure fuel inlet ports, acts as a fuel spill edge.

Afterburner valve 90, of slide valve type, manufactured of bronze, is precision-matched with sleeve 89, the diametral clearance being 0.009-0.012 mm. The mating parts are finished accurate within ± 0.001 mm. The valve has a wide cylindrical groove admitting fuel to the cut-off valve and a narrow recess to drain fuel from the servomechanism spring chamber (when the afterburner is turned off).

Sleeve 98 has on the outer diameter, on its lower portion, a small dia. groove with slits designed to direct fuel to the piston from the duct upstream to the constant pressure valve.

Fuel is by-passed from the servomechanism spring chamber into the low pressure pipe line (at fuel pump inlet) through the upper four holes, 4 mm in dia.

Piston 91, secured by nut 94, is installed on the afterburner valve groove. Piston 91 is similar in construction to the wobble plate servomechanism piston. Fitted on the nut are adjusting washer 95, lock 96, and cap 97. The piston divides the servomechanism chamber into fuel and spring chambers.

From the constant pressure valve fuel is admitted into the fuel chamber through the throttling assembly (See Fig. 14) at a 70-150 cm³/min. flow rate, the pressure upstream to the throttling assembly being 10 kg/cm².

The spring chamber houses spring 99 and spring support 92. Washer 100 is fitted between spring support 92 and the groove face on the housing or switch 101.

Cut-Off Valve

The cut-off valve unit (See Fig. 25) is positioned in the pump body duct normal to the afterburner valve. It comprises the following parts: a valve, a valve seat, a plug with rod, and a spring.

Steel seat 124 of the valve is screwed into the pump body. A circular groove is made in the face of the seat protruding shoulder. The side surface of the shoulder has eight 1.5 mm dia. holes drilled in the circular groove. The holes as well as the circular groove are packed with grade 4327 rubber.

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Valve 120, of stainless steel, has a stem with a bored hole to receive rod 121 and a head with a 0.2 mm annular collar, pressed to the rubber ring of the valve seat.

Spring 123 with adjusting washer 122 set the valve to open at 0.5 kg/cm² pressure.

Fuel Valve

The fuel valve assembly (See Fig. 25) comprises essentially the following main parts: plunger 116, sleeve 117, spring 114, spring retainers 113, cup 115, adjusting screw 111. The fuel valve unit is installed in the stepped well of the fuel pump body. Sleeve 117 is installed in the smaller dia. well hole with a 0.006-0.037 mm clearance. To seal the sleeve, rubber rings are placed under its face as well as its two cylindrical grooves. The sleeve is made of steel, its central hole is machined accurate within ± 0.001 mm. The sleeve faces have cylindrical grooves. The sleeve outer surface has 2 parallel flats with through slits designed to admit fuel to the burners.

The fuel valve plunger 116, of bronze, is thoroughly lapped on its outer dia. and sized with sleeve 117 with a 0.010-0.014 mm diametrical clearance. The plunger end face edges serve as cut-off edges. The larger hole of the well houses cup 115 with a 0.03-0.15 mm clearance. The cup face rests against the plunger sleeve face. Several holes drilled in the cup serve to drain fuel which has seeped in through the plunger.

Cover 112, mounted on the pump body, is secured by four studs. The cover with its centring collar rests against cup 115 translating axial pressure onto a rubber ring. Another rubber ring seals the joint between the pump and the cover. Screw 111, turned into the threaded hole of the cover, is used to adjust the spring at a definite valve opening pressure. Adjustment completed, screw 111 should be locked with a nut. Cup 115 is fitted on the free end of the screw.

Interlocking Device Switch (Electrocontactor)

The interlocking device switch (See Fig. 25) is mounted inside the pump body and comprises the following parts:

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a contactor housing, a rod, a sleeve, a spring, a diaphragm, a cover, and a contactor complete with a switch.

Contactor housing (switch) 101 is an aluminium casting. Bronze sleeve 103 is pressed into the central orifice of the housing with a 0.02-0.04 mm negative allowance. Rod 105 travels in sleeve 103 with a 0.010-0.014 mm clearance. The contactor housing, installed on the pump body, is located with a special shoulder and secured with four studs. Mounted on these studs are diaphragm 110 and contactor cover 109. Switch 108 (type KB-6) is installed in a special recess of the cover, while connector plug 102 is secured with four screws to the cover boss. The switch wires are soldered to the connector plug contacts. The electrocontactor should operate 5-8 sec. after afterburner fuel pressure has risen to the full value which is adjusted by washer 95 (whose thickness is properly selected).

Electromagnetic Switch

Electromagnet body 127 (Fig. 26) houses coil 133, consisting of a frame and winding. The coil is installed in true alignment with cylinder 130, soldered to the electromagnet body and serving as guide of core 134 when the latter is shifting inside the cylinder.

Pole 129, inserted into the cylinder from the side of the electromagnet body flange, rests against ring 128 and presses on sealing ring 132, thus providing for proper airtightness. Positioned in the pole opening is rod 131.

When assembling the electromagnetic switch, select ring 128 (adjusting washer) so as to ensure projection of the rod by 0.3-0.45 mm beyond the electromagnet body.

Four screws secure plug connector 136 to steel panel 135 in the body groove of electromagnet 127.

The ends of coil 133 winding are threaded through two holes in the panel and soldered to the contacts of the plug connector. Nut 137 fastens the panel to the electromagnet body. Screw 138 which couples cylinder 130 with the electromagnet body passes through the panel holes. A piece of wire is threaded through holes in the head of screw 138 to seal the electromagnetic switch.

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The magnet circuit of the electromagnetic switch is closed through electromagnet body 127, panel 135, core 134 and pole 129.

The inner cavity of the electromagnetic switch is filled with liquid compound ПГА-450 (КОМПАВНД ПГА-450).

After assembly the electromagnetic switch is installed on the pump body and fastened with six screws. Rubber ring 31 in the circular groove of the pump body seals the joint.

After 20-26 V D.C. current is fed through the electromagnet winding, the core is attracted to the pole and pushes the rod out of the pole. The rod in its turn pushes valve 30 and closes it.

Fuel stops flowing through jet 29 and is delivered now under the piston of the afterburner valve servomechanism.

After the current is switched off the valve spring returns the rod to its initial position.

Constant Pressure Valve

The constant pressure valve is housed in the pump body (Fig. 22) and consists of steel plunger 35 travelling in steel sleeve 36, which is pressed into the pump body with a 0.02-0.03 mm negative allowance. When coupling the plunger with the sleeve a 0.010-0.014 mm diametral clearance is observed. The mating surfaces should be finished accurate within VVV 10. The plunger has a central duct and a 0.8 mm through boring which connects the high and low pressure cavities.

The central duct with its four holes communicates with the groove on the plunger, which forms the cut-off edge.

The outer surface of the plunger cylinder has five relief grooves, the outer surface of sleeve 36 has a cylindrical groove to which fuel is fed from the high pressure cavity. Six holes connect the groove with the inner surface of the sleeve.

Spring 34, whose tightening is adjusted by shims 33, acts on the plunger shoulder while its other end rests on plug 32 screwed into the fuel pump body. The spring chamber communicates with the fuel channels at the pump inlet where

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fuel is delivered under pressure.

The constant pressure valve keeps the pressure of fuel delivered under the piston of the afterburner valve servomechanism constant by regulating the rate of fuel flow from the high pressure chamber.

Fuel By-Pass Valve

Fuel by-pass valve unit (Fig. 27) in the fuel pump body contains bronze plunger 139, travelling in steel sleeve 140 which is pressed in the fuel pump body with a 0.02-0.03 mm negative allowance. When the plunger and the sleeve are precise-matched, a 0.010-0.014 mm diametral clearance should be observed. The mating parts must be thoroughly finished accurate within VVVV 10.

Spring 141, whose one end is on the plunger shoulder, rests with its other end on valve stop 142 positioned in plug 143.

With the afterburner turned on, plunger 139 is closed as the pressure drop across the afterburner valve is not enough to overcome the tightening of spring 141. With the afterburner turned off the pressure upstream to the plunger is determined by the tightening of spring 141 (18 kg/cm²). Excessive fuel from the high pressure pipe line is returned into the low pressure fuel line. The jet connects the spring chamber of the fuel by-pass valve with the low pressure cavity.

Fine Filter

The fine filter (See Fig. 21) is designed to filter fuel pumped to the constant pressure drop valve and the afterburner valve servomechanism. Its construction, described above, is similar to that of the fine-mesh filter of the HP-10A unit.

Air Relief Valve

Presence of air in the inner cavities of the fuel pump unit may adversely affect its adjustment.

Ball type valve 125 (Fig. 25) is incorporated in the unit to evacuate the air from the inner cavities of the pump.

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VII. HP-10A AND HP-11A UNITS GENERAL REQUIREMENTS FOR MOUNTING AND OPERATION

Prior to installation on the engine remove corrosion-preventive compound from the external surfaces of the units.

When reprocessing the units do not remove protecting caps and bushings; the latter will be removed only during mounting procedures.

When the unit is being mounted on the engine its shaft should freely enter the engine drive sleeve.

Prior to installation the connecting pipes must be carefully flushed. Before joining the pipes the threaded portions must be coated with clean aviation oil. It is prohibited to use special lubricants for the purpose, for example, grease grade 5V.

When jointing control rods make use of locating notches and stops of the unit control system.

The position of the HP-10A unit control lever retainer against the sector middle notch marks the middle of the idling rating sector. The extreme notches (of the 3 ones on the sector) mark the limits of the idling rating sector.

Stop screw 1 (Fig. 28) indicates the CUT-OFF (C10N) position. The FULL THROTTLE (ПОЛНУЮ ГАЗ) position is marked by a notch on the sector. The control rod is linked to the engine when the control lever is set against the FULL THROTTLE notch.

The universal joints of the throttle valve control must be so fastened as to ensure smooth travel without any play.

After mounting and adjusting the units on the engine, lock all the details where required.

The pipe unions screwed into the unit bodies are not provided with locking devices, therefore, when backing off the nuts and caps hold the pipe unions against rotation with a wrench.

After mounting the pump on the engine, check the fuel system for leakage as indicated in the Manufacturer's Instructions.

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Prior to filling the system with fuel it is necessary to bleed air from the unit cavities through specially designed valve 6 (See Fig. 28) in the HP-10A unit and valve 125 (Fig. 25) in the HP-11A unit.

The engine starting should be accomplished in compliance with the manufacturer's instructions.

Prior to engine starting engage the booster pump and build up a 1.6-2.6 kg/cm² pressure before the HP-10A and HP-11A units and a 1.8-3.4 kg/cm² pressure before the HP-10A and HP-11A units.

1. Adjusting HP-10A Unit on Engine

Adjustment of the HP-10A unit on the engine will be accomplished by means of regulating the following parameters:

1. engine automatic starting;
2. engine idling rating r.p.m.;
3. engine maximum speed;
4. switching in of the interlocking limit switch;
5. engine acceleration rate;
6. synchronous operation of throttle valve control levers in case the aircraft is powered by more than one engine.

Checking and Adjusting Engine Idling R.P.M.

The idling r.p.m. should be adjusted with the engine warmed up and will be done in the following sequence:

Set the engine control lever so that the indicator of the unit control lever is against the middle notch of the idling rating sector. Adjust the idling r.p.m. by turning head 7 of the idling rating screw (Fig. 28).

When head 7 is turned clockwise, the idling r.p.m. increases and vice versa.

One turn of the idling rating screw changes the idling speed by \approx 800 r.p.m.

Adjusting Engine Starting

This adjustment is accomplished with screw of the starting control unit membrane spring (Fig. 29) and by replacing the

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bleed jet of the pipe feeding air to the starting control unit as directed in the Manufacturer's Instructions.

In case the engine is loggy (does not respond to shifting of the control lever) or if the engine gains speed too slowly, turn in the membrane spring screw or fit a smaller dia. bleed jet.

Should flame be ejected at engine starting, back off the spring screw or fit a larger dia. bleed jet. If the above mentioned troubles occur at the initial stage of engine starting with $n < 2000$ r.p.m. the engine is adjusted by regulating the membrane spring. If malfunctioning occurs when starting is almost accomplished, adjust the engine by regulating the bleed jet within 1.2-2.7 mm in dia. It is prohibited to turn the membrane spring screw out beyond the face of pipe union 10.

Adjusting Maximum R.P.M.

Maximum r.p.m. is adjusted after the engine is warmed up in the following sequence.

By shifting smoothly the control lever until it rests against screw 5 (See Fig. 28) check the maximum r.p.m. In case it does not comply with the Specifications, accomplish necessary adjustments. To this effect screw off cap 2 (Fig. 29) of the hydraulic decelerator stop screw, slacken the check nut and, holding it with a wrench, adjust the r.p.m. by manipulating screw 1. Turning this screw in decreases the r.p.m. and vice versa. One turn of screw 1 changes the engine speed by 500-700 r.p.m. Adjustment over, hold screw 1 against rotation with a wrench, screw on the check nut, reinstall and lock the cap.

At the manufacturing plant screw 5 of the throttle valve lever (See Fig. 28) is adjusted intentionally to greater r.p.m. than the decelerator stop permits.

In case further attempts to adjust maximum speed with screw 5 prove to be ineffective and further turning out decelerator stop screw does not increase the speed, turn out screw 5 until the speed attained is 50-70 r.p.m. greater than that required. Adjust the speed by means of the decelerator stop screw.

Slacken the lock nut before adjusting the throttle lever by screw 5. Hold the check nut from rotation with a wrench, adjust the r.p.m. and, holding screw 5 against turning by a wrench, screw on and secure the lock nut.

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Turning out the throttle lever stop screw increases the speed and vice versa; one turn of the screw changes the speed by 60-70 r.p.m.

Note: To finally check the maximum r.p.m. run the engine at this speed for 1-2 min.

Adjusting Engine Acceleration

Engine acceleration is adjusted by the acceleration control unit and the hydraulic decelerator.

The HP-10A unit has the following elements designed to adjust engine acceleration:

1. membrane spring screw 5 (Fig. 29);
2. a bleeding jet on the acceleration control unit air feed pipe;
3. the hydraulic decelerator throttling assembly.

The membrane spring screw of the acceleration control unit regulates the pressure at which the acceleration valve opens. Turning in the screw increases the pressure on the membrane, the time of acceleration is decreased and vice versa. Do not turn screw 5 beyond pipe union 7.

Engine acceleration adjustment through the membrane spring screw is most effective up to 7500-8000 r.p.m.

Engine acceleration beginning with 7500-8000 r.p.m. up to maximum speed is adjusted by selecting a bleeding jet of a proper dia. Larger dia. jets increase the time of acceleration and vice versa.

The time of engine acceleration from the speed of automatic operation up to the maximum r.p.m. is adjusted by replacing decelerator throttling assembly 4 (See Fig. 29). With the capacity of the throttling assembly decreased the time of engine acceleration increases, and vice versa. The decelerator throttling assemblies are interchangeable within 30-80 cm³/min. capacity.

To check engine acceleration proceed as follows. After the engine has been warmed up set it to run at idling r.p.m. and only then, within 1.5-2 sec., shift the throttle lever

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to the FULL THROTTLE stop. The time of engine acceleration from idling rating to maximum rating and acceleration rates is specified in the Instructions of the engine Manufacturer.

Before final check of engine acceleration, check the limit switch for operation (as indicated by the oil pressure warning lamp) when accelerating the engine to normal rating.

If the r.p.m. of the limit switch operation does not fall within the specified limits readjust the switch.

Turning out of limit switch screw 3 increases the r.p.m. of the switch operation and vice versa.

Notes: 1. After carrying out adjustment by means of the above mentioned screws, tighten properly the check nut and the cap and safetywire the latter.

2. All the adjustment procedures performed with the aid of the elements mentioned above should be duly recorded in the unit Certificate.

Adjusting Control Levers

The construction of the control lever makes for adjustment of fuel consumption, since the angle of lever turn determines the throttle valve opening. This is a most valuable feature especially with aircraft powered by two or more engines. The position angle of the unit control lever may change relative to the control lever position in the pilot's cockpit. Lever 4 has externally toothed hub 3 (See Fig. 28). Shifting the lever from one tooth to the neighbouring one changes its position by 15°-17°.

Besides, the lever arm length may be changed from 44 to 60 mm through shifting of the lever toothed rack.

CAUTION. When adjusting the control levers take care not to disturb the control levers turn limiter adjustment on the splines.

Checking Engine Control System

To check the engine control system smoothly shift the control lever from the CUT-OFF (CTON) stop to the FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop and backwards.

The lever must shift without binding and jerks.

When setting the engine control lever in the CUT-OFF (CTON) or FULL THROTTLE (ПОЛНЫЙ ГАЗ) position, unit control lever 4 (See Fig. 28) must be tight against the respective unit stops.

2. Adjusting HP-11A Unit on Engine

The adjustment of the HP-11A unit is carried out basically at the Manufacturing plant.

When adjusting the HP-11A unit on the engine a necessity for regulating the time of turning on fuel delivery to the afterburner may arise. This is effected by replacement of the pump throttling assembly in order to obtain a capacity within 100-300 cm³/min. or by selection of the servopiston damper dia. within 0.5-0.7 mm. The adjustment of fuel consumption with regard to altitude, during aircraft acceptance tests, may be accomplished by the screws of the barostat or fuel valve springs.

3. Special Operating Instructions for HP-10A and HP-11A Units

The HP-10A and HP-11A units have a number of precision pairs operating in the fuel medium. The pairs are matched with precision and lapped with 0.007-0.014 mm clearance. Contaminated fuel may cause seizing and premature wear of these parts. Therefore, a fine filter, arresting particles whose magnitude is about that of the clearance, should be installed in the pipe line feeding fuel to the units.

An air filter should be installed where air is let in from the compressor to the acceleration control unit and to the starting control unit of the HP-10A unit.

To avoid overheating of the HP-11A fuel pump, when it runs with the afterburner valve cut out, have the return line from the unit rotor cavity connected to the suction line so that the return line fuel be fully consumed by the HP-10A fuel pump.

HP-10A unit has a manual control range from idling r.p.m. to 8200 r.p.m. and an automatic control range from n=8200 r.p.m. (r.p.m. of beginning of automatic operation) up to maximum r.p.m.

Within the manual control range, with the control lever in the same position, the engine r.p.m. increases with altitude. This accounts for the following peculiarities of the engine control.

1. When flying at different altitudes the engine control lever attains an idle travel range, within which the control lever shifting does not bring about changes in the engine r.p.m. This idle travel range is located within the manual engine control zone and its length depends on the flight altitude.

2. When the aircraft is gliding with the control lever steady within the manual control range, the engine r.p.m. decreases as flight altitude decreases.

3. In flight, if the automatic control system fails, resort to manual control which is effected by operating the throttle valve.

4. Processing and Deprocessing Units

Prior to installation on the engine, remove the corrosion-preventive compound from the unit outer surfaces by washing them with kerosene or gasoline or by blowing the surfaces with gasoline (or kerosene) - compressed air mixture on a special stand.

It is allowed to remove the preservative coating with a jet of oil, heated to a temperature not above 50°C.

Note: When removing the corrosion-preventive compound see that neither kerosene (gasoline) nor corrosion-preventive compound gets into the membrane cavity of the acceleration and starting control units (unit HP-10A) as well as into the aeroid chamber of the HP-11A unit and into limit switch.

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es of both units. Do not remove the protecting caps and bushings from the unit.

Removal of corrosion-preventive compound from the inner surfaces of the units is carried out with the engine running in compliance with the Manufacturer's Instructions.

To apply corrosion-preventive coating to the units mounted on the engine, pump clean oil, grade MK-8, or transformer oil, through the unit, with the engine running, as directed in the Manufacturer's Instructions. Use 5 to 8 lit. of oil to pump the unit through.

It is allowed not to apply corrosion-preventive coating to a unit inactivated for a period up to 7 days provided that its fuel system and accessories are filled with fuel. Weekly start the engine, warm it up and check as set forth in the Manufacturer's Instructions.

In case the engine or the aircraft is inactivated and the fuel system is drained, process the units for a short-term storage on the engine or after removal from the engine in not more than 24 hours after draining the fuel.

Units and accessories removed from the engine and subject for storage during more than 24 hours must be processed in compliance with the respective Instructions.

VIII. TESTING AND ADJUSTING UNITS ON SPECIAL STANDS

1. HP-10A Unit

The units are tested on a stand diagrammed in Fig. 30. For tests use fuel grade T-1 or TC-1.

Testing and adjustment of units, except special cases, should be carried out under the following conditions.

1. Fuel pressure at pump inlet $P_{\text{fuel}} = 1.6 - 2.6 \text{ kg/cm}^2$.
2. The distributing valve outlet connections of the primary and main fuel manifolds should be fitted with respective jets. The capacity (Q) of the primary manifold jet at 30 kg/cm^2 pressure (P_{fuel}) should be 455 lit/hr, that of the main manifold jet at 40 kg/cm^2 pressure (P_{fuel}) should be 3520 lit/hr.

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Notes: 1. Tolerance for jet calibration is ± 1 per cent of consumed fuel.

2. During operation the fuel pressure downstream from the jets should not exceed $2 \pm 0.1 \text{ kg/cm}^2$.

3. Maintain 2-3 kg/cm^2 air pressure in the membrane chambers of the acceleration valve and starting control unit. A blind plug may be fitted instead of a bleeding jet.

The operation of the units under test should comply with the following specifications:

1. The CUT-OFF (CTON) sector formed by the angle of throttle lever turn from the CUT-OFF stop to the beginning of fuel consumption from the unit at $n=1200-1800 \text{ r.p.m.}$ must be $\alpha=6 \pm 3^\circ$. The amount of fuel flowing through the outlet pipe connections with the throttle lever set against the CUT-OFF (OCTAHOB) stop must not exceed 100 $\text{cm}^3/\text{min.}$

The CUT-OFF (OCTAHOB) sector is adjusted with stop screw 1 (See Fig. 28).

2. The constant pressure drop valve must ensure fuel pressure drop across the throttle valve within $10 \pm 1 \text{ kg/cm}^2$. The test is carried out at $n=1200-1300 \text{ r.p.m.}$ and the throttle lever positioned $25-35^\circ$ short of the CUT-OFF (OCTAHOB) stop.

The constant pressure valve operation is adjusted by changing the tightening of spring adjusting washer 107 (See Fig. 17). (Do not fit more than two washers).

Check the stability of valve adjustment by raising the speed up to 2200-2300 r.p.m. Deviation within tolerances is allowed.

3. The constant pressure valve must provide for fuel pressure at the valve outlet within $10 \pm 1 \text{ kg/cm}^2$. The check is carried out at $n=1200-1800 \text{ r.p.m.}$ with the throttle lever positioned $25-35^\circ$ short of the CUT-OFF (OCTAHOB) stop. The constant pressure valve is adjusted by changing the tightening of spring adjusting washer 107 (See Fig. 18).

(Do not fit more than two washers).

4. The r.p.m. of beginning of automatic operation must be 3040-60 r.p.m. at $Q = 2200 \pm 125 \text{ lit/hr.}$

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The throttle valve lever turn angle α from the CUT-OFF (ОСТАВ) stop to the beginning of automatic operation must be $50 \pm 5^\circ$.

The r.p.m. of the beginning of automatic operation is adjusted by tightening or loosening spring 28 (See Fig. 18) by means of turning threaded sleeve 113.

By turning the throttle valve lever the throttle valve needle is set for fuel consumption required at the beginning of automatic operation, after which bushing 115 is turned in by means of stop 114 as far as spring retainer 116 permits. The bushing-to-retainer contact is controlled by the change in the position of the throttle valve lever. A $2-3^\circ$ deviation of the lever from the selected position towards CUT-OFF (ОСТАВ) stop should not affect the balanced r.p.m. Moving the lever $2-3^\circ$ towards FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop increases the engine balanced r.p.m.

- Notes:** 1. R.p.m., at which pressure downstream from the throttle valve decreases by $2-5 \text{ kg/cm}^2$ with smooth increase of the unit r.p.m. and the cocks of the unit and test stand in the same position, is called balanced r.p.m.
2. Fuel consumption $Q = 2200 \pm 125 \text{ lit/hr}$ is adjusted at $n = 2500 \text{ r.p.m.}$ (the throttle valve lever is brought from the CUT-OFF (ОСТАВ) stop side).
5. Maximum speed of $3565^{+30}_{-10} \text{ r.p.m.}$ is adjusted by screw 129 of the hydraulic decelerator servopiston (See Fig. 18). The FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop screw position must be at $n = 3620 \pm 20 \text{ r.p.m.}$
- The position of the retainer at $n = 3565^{+30}_{-10} \text{ r.p.m.}$ is marked by a notch on sector 2 (See Fig. 28). The balanced r.p.m. is checked as directed under Para. 4.
- Check the engine for stable operation during acceleration to maximum r.p.m. by shifting the throttle lever to the maximum speed stop three or five times. The engine maximum r.p.m. should fall within the specified limits.
6. The throttle valve lever turn angle from the CUT-OFF (ОСТАВ) stop to the FULL THROTTLE (ПОЛНЫЙ ГАЗ) notch must be $100 \pm 5^\circ$. Adjusting margin of screw 129 must provide for acceleration

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tion to at least $n = 3700 \text{ r.p.m.}$

7. When the throttle valve lever is shifted towards the FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop the electric contactor must operate at $n = 3490 \pm 50 \text{ r.p.m.}$ ^x

When the throttle valve lever is shifted towards the CUT-OFF (ОСТАВ) stop the electric contactor must operate at $n = 3490 \pm 50 \text{ r.p.m.}$ The margin for adjusting electric contactor operation with the screw should be within $\pm 75 \text{ r.p.m.}$

Notes: 1. The electric contactor operation is checked with a warning lamp.

2. The following method allows to determine the speed at which the electric contactor operates: the throttle valve lever is shifted till the electric contactor operates. The lever is fixed in this position and the balanced r.p.m. is calculated as specified in Para. 4. The r.p.m. obtained is considered the r.p.m. at which the electric contactor operates.

8. At $n = 3500 \text{ r.p.m.}$ with the throttle valve lever shifted abruptly from the IDLING RATING (МАЛЫЙ ГАЗ) sector to the FULL THROTTLE stop the time of the hydraulic decelerator servopiston operation must be within 10-13 sec.

The time of operation is calculated from the moment of shifting the throttle valve lever to the moment when fuel pressure upstream from the distributing valve increases by $2-3 \text{ kg/cm}^2$.

The throttling assembly of the decelerator is selected within $30-80 \text{ cm}^3/\text{min.}$ flow rate.

9. At $n = 3500 \text{ r.p.m.}$ and p_f at the unit outlet in the primary manifold or the distributing valve with the throttle valve lever at FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop (notch) the pump maximum capacity Q must be $4180^{+200} \text{ lit/hr.}$

Fuel pressure drop across the throttle valve must be not over 7 kg/cm^2 .

Use the test stand cock to obtain a fuel pressure of 80 kg/cm^2 . The fuel pump maximum output is adjusted by manipulating

^x In units up to No. K607H353, except series A, the electric contactor was adjusted to operate at $n = 3330 \pm 65 \text{ r.p.m.}$

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ing the wobble plate maximum delivery stop screw 52 (See Fig.11).

10. With the idling rating valve fully closed or fully open, at $n = 1200$ r.p.m. and the throttle valve lever positioned in the middle of the IDLING RATING (МАЛЫЙ ГАЗ) sector the pump output must be as follows:

1. With the valve open to full capacity - not less than 570 lit/hr;

2. With the valve closed-not more than 430 lit/hr.

11. At $n = 1200$ r.p.m. and the throttle valve lever in the middle of the IDLING RATING (МАЛЫЙ ГАЗ) sector the capacity must be 480 ± 30 lit/hr.

The adjustment is done with the idling rating valve.

12. The IDLING RATING (МАЛЫЙ ГАЗ) sector α must be within $12^\circ - 22^\circ$ as from the moment fuel consumption no longer increases to the moment when fuel consumption starts increasing (when the throttle valve lever is shifted from the CUT-OFF (ОТКАНОВ) side).

The middle of the IDLING RATING (МАЛЫЙ ГАЗ) sector which must be within $\alpha = 20 - 25^\circ$ from the CUT-OFF (ОТКАНОВ) stop is marked with a notch.

The IDLING RATING (МАЛЫЙ ГАЗ) sector is marked 5° each side from the middle notch.

Shifting of the throttle valve lever within this sector should not bring about changes in fuel consumption in excess of 20 lit/hr.

13. At $n = 300$ r.p.m. and the throttle valve lever on the IDLING RATING (МАЛЫЙ ГАЗ) sector the pump output must be not less than 200 lit/hr.

14. If the throttle valve lever is shifted within $\pm 10^\circ$ from the balanced position at 3400 ± 50 r.p.m. the servomechanism must operate within 7 to 12 sec.

The mechanical operating period is calculated by the changes in fuel pressure downstream from the throttle valve (from 30 to 80 kg/cm²). The operation speed is adjusted by selecting a 100-150 cm³/min. flow rate throttling assembly.

From 80 kg/cm² fuel pressure at the throttle valve outlet is set with the throttle valve lever shifted $\pm 10^\circ$ from the balanced r.p.m. position. To obtain the required

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pressure use the test stand valve (positioned downstream of the equivalent jets).

15. The unit sensitivity must be within ± 30 r.p.m.

Given below is the method of checking the unit sensitivity.

1. Set the throttle valve lever to a position corresponding to a balanced speed of 3400 ± 50 r.p.m.

2. With the unit speed smoothly increasing, note the r.p.m. at which fuel pressure at the throttle valve outlet decreases to $5 - 15$ kg/cm².

3. Increase the speed until the servomechanism operates, then decrease the speed and note the r.p.m. at which fuel pressure increases by $5 - 15$ kg/cm² from the nominal value.

The difference between the r.p.m. registered under Items 2 and 3 must not exceed 30 r.p.m.

16. The distributing valve operation should comply with the following specifications:

1. The pressure at which the valve opens the passage to the primary manifold is 4 ± 1 kg/cm². The beginning of the valve opening is determined by the quantity of fuel flowing through the manifold ($Q = 100 - 350$ cu.cm/min.).

2. The pressure at which the valve opens the passage to the secondary manifold (main line) is 8.5 ± 1 kg/cm². The beginning of the valve opening is determined by the quantity of fuel flowing through the main manifold ($Q = 600 - 1700$ cm³/min.).

3. At $n = 1200$ r.p.m. and the throttle valve lever at the middle of the IDLING RATING (МАЛЫЙ ГАЗ) sector fuel pressure in the primary manifold (before the equivalent jets) should be 12 ± 0.5 kg/cm².

4. With fuel pressure at unit inlet of 2.6 kg/cm², the throttle valve fully open and the rotor at halt, fuel leakage through the pipe union of the distributing valve should not exceed 50 cu.cm/min.

5. Total fuel consumption through the distributing valve primary and main manifolds should comply with the following data:

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Fuel pressure p_f before distributing valve, kg/cm^2	Total fuel consumption through distributing valve, $Q \text{ lit/hr}$
10	300 - 390
15	585 ± 15
20	820 - 930
30	1440 - 1650
50	2680 - 2960
70	3770 - 4100

The valve is checked for opening a passage to the respective manifold at $2 \pm 0.1 \text{ kg/cm}^2$ pressure before the unit.

The distributing valve is adjusted with spring of screw 11 (See Fig. 29) and checked for total fuel flow through the manifold by smoothly raising the pressure at the distributing valve inlet up to the pre-set value.

17. The acceleration control unit should operate at $15_{-1}^{+1} \text{ kg/cm}^2$ fuel pressure before the distributing valve and zero excessive pressure.

Adjustment is carried out with adjusting screw 5 of the acceleration control unit (See Fig. 29).

18. The operation of the starting control unit should comply with the specifications given in the Table below:

R.p.m.	300 ± 25	900 ± 25
Fuel consumption via distributing valve, lit/hr	200 ± 50	Idling rating Q
Air pressure p_2 in the starting control unit membrane chamber, kg/cm^2	0.03 ± 0.005	0.17 ± 0.02

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Adjustment is accomplished with adjusting screw 9 of the starting control unit membrane spring (Fig. 29). The throttle valve lever should be positioned in the middle of the IDLING RATING (МАЖНІІІ ГАЗ) sector.

Air at p_2 pressure is admitted into the membrane chamber through a 3 mm dia. jet and is routed from the chamber via a 1.5 mm dia. jet.

19. At an engine speed of 3100 r.p.m. and the minimum pressure valve cut out, the minimum fuel delivery stop is set at 200^{+20} lit/hr fuel consumption. To cut out the minimum pressure valve it is necessary to place a 4 mm washer under the valve shoulder.

The minimum pressure valve is adjusted to 300 ± 20 lit/hr fuel consumption (at an engine speed of 3500 r.p.m. and the throttle lever on the IDLING RATING (МАЖНІІІ ГАЗ) sector) by changing the valve spring tightening through fitting spring adjusting washers 107 (See Fig. 20). The total thickness of the washers should not exceed 6 mm.

The minimum pressure valve is adjusted after the acceleration control unit has already been adjusted without feeding pressurized air P_2 into the acceleration control unit. Fuel consumption is measured after shifting the throttle valve lever from the FULL THROTTLE position to the IDLING RATING (МАЖНІІІ ГАЗ) sector.

The stability of the valve operation is checked by releasing pressure two or three times through shifting the throttle valve lever from the middle of the IDLING RATING (МАЖНІІІ ГАЗ) sector to the FULL THROTTLE (ПОЛНІІІ ГАЗ) stop at any speed.

In case fuel pressure is increased to a value limited by the acceleration valve (without feeding air into the acceleration control unit), the lever is shifted to the middle of the IDLING RATING (МАЖНІІІ ГАЗ) sector within 1-2 sec. The difference in fuel consumption should be within 280-320 lit/hr at $n=3500$ r.p.m.

Note: When adjusting the valve it is allowed to select the jet for the wobble plate servopiston with a 0.7-0.8 mm dia. orifice.

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20. With the unit inoperative, the fuel pressure at its inlet being 0.5 kg/cm^2 fuel leakage through the outlet pipe unions of the distributing valve should not exceed 6 cu.cm/min.

21. With the unit inoperative, the inlet fuel pressure p_f being 0.5 kg/cm^2 , fuel leakage via the fuel pressure measuring pipe union should not exceed 20 cu.cm/min.

22. At 3500 r.p.m. and the throttle valve lever set against the FULL THROTTLE (ПОЛНОГО ГА3) stop the total fuel leakage into the atmosphere is not to exceed $25 \text{ cm}^3/\text{min.}$

23. All the joints of the unit must remain airtight for 10 min. at 3500 r.p.m., under $80\text{--}85 \text{ kg/cm}^2$ fuel pressure at the unit outlet in the primary manifold of the distributing valve (with the throttle valve open) and at $2.6\text{--}2.8 \text{ kg/cm}^2$ fuel pressure at pump inlet.

Note: When checking the unit as specified in Para. 23, the fuel temperature is not to exceed 40°C . At higher fuel temperatures or in case the electric motor becomes overheated interrupt the test to cool the unit.

2. HP-11A Unit

For testing the units use the test stand diagrammed in Fig. 31.

Use fuel grade T-1 or TC-1.

Test and adjust the units (except when specified otherwise) under the following conditions:

- (1) the unit pump r.p.m., 3565 ± 20
- (2) fuel pressure at pump inlet $p_f = 1.6\text{--}2.6 \text{ kg/cm}^2$
- (3) apply $20\text{--}26 \text{ V D.C.}$ to cut in the electromagnet
- (4) at the fuel valve outlet an equivalent jet is fitted providing for fuel consumption of $3700 \pm 40 \text{ lit/hr}$ at $p_f = 90 \text{ kg/cm}^2$ (when operating the jet so that fuel pressure downstream to the jet does not exceed 5 kg/cm^2).

When tested on a stand the units should comply with the following specifications:

1. With the electromagnet cut out the fuel pressure p_f at the afterburner valve inlet should be $18 \pm 3 \text{ kg/cm}^2$.
2. With the electromagnet cut in and pressure p_f in the aneroid chamber equal to p_0 (atmospheric pressure on the test day) the constant pressure valve should provide for fuel pressure p_f at the valve outlet $10 \pm 1 \text{ kg/cm}^2$.

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Adjustment is carried out by changing tension of the valve spring through fitting spring shims 33 (Fig. 22). (Do not fit more than three shims).

3. The HP-11A unit altitude performance should comply with the following tabulated data:

Pressure p_f in aneroid chamber, mm Hg	70	110	184	294	441	588	760	1200
Fuel consumption Q , lit/hr (within the limits of)	250	380	720	1200	1740	2230	2780	3620
	350	480	850	1350	1950	2440	3000	3740

Adjustment is carried out by means of the fuel valve spring adjusting screw 111 (See Fig. 2b) with the electromagnet cut in.

- Notes:
1. Fuel consumption at $920\text{--}1178 \text{ mm Hg}$ pressure p_f in the aneroid chamber is limited by the wobble plate maximum fuel delivery stop.
 2. At pressure $p_f = 70 \text{ mm Hg}$ in the aneroid chamber set the wobble plate minimum delivery screen at $Q = 250\text{--}280 \text{ lit/hr}$ fuel consumption.
 3. The pump altitude performance is adjusted by means of the aneroid screw (Fig. 32), barostat valve spring adjusting screw, by turning the eccentric, the fuel valve spring screw and by selecting the block and ring with a $4.0\text{--}4.6 \text{ mm dia.}$
 4. Altitude performance data are registered while the pressure in the aneroid chamber is gradually decreasing from $p_f = 760 \text{ mm of Hg}$ up to altitude pressure and while it is increasing from $p_f = 760 \text{ mm of Hg}$ to boost pressure.

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5. Performance hysteresis at points 110, 184, 294, 241, 588 should not exceed the adjusted value of fuel consumption by more than 50 lit/hr. To eliminate hysteresis it is allowed to fit a 0.8 mm dia. jet instead of the servopiston jet (1 mm in dia.).

4. At $p_1=220$ mm Hg pressure in the aneroid chamber the time required for opening and closing the afterburner valve should be:

- (1) from the moment of switching on the electromagnet to beginning of pressure increase - not over 2.5 sec.;
- (2) from the moment pressure begins increasing at the equivalent jet inlet to the moment the process is over - within 2 - 4 secs;
- (3) after pressure increase is over the electrocontactor should switch on in 5-8 secs;
- (4) the time of afterburner valve complete closing - not over 1.5 sec.

Adjustment is carried out by means of selecting a proper throttling assembly (See Fig. 14) with a 70-150 cu.cm/min. flow rate or by a damper.

5. The pump capacity should remain stable when the electromagnet supply voltage drops down to 20 V.

The check is carried out as prescribed in Para. 3 at 920 mm Hg pressure in the aneroid chamber.

6. The amount of fuel delivered from the pump rotor cavity into the fuel inlet line with the electromagnet inoperative should remain within 300-600 lit/hr. limits.

7. At $n=3565 \pm 20$ r.p.m., with the electromagnet out out, pressure p_1 in the aneroid chamber being equal to B_0 , fuel pressure p_2 at the unit inlet being 2.7 kg/cm², fuel leakage via the pipe union delivering fuel to the burners should not exceed 10 cu.cm/min.

8. At $n=0$, with the electromagnet deenergized, fuel pressure at the unit inlet p_2 being 0.5 kg/cm², fuel leakage through the pipe union delivering fuel to the burners should not exceed 1 cu.cm/min. during a three minute check.

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Note: It is allowed to adjust the cut-off valve spring by washer 122 (See Fig. 25) prior to adjusting the unit altitude performance. Do not fit more than two washers under the spring.

9. Total fuel leakage into the ambient atmosphere via the vent system is not to exceed 15 cu.cm/min.

10. The unit joints should remain airtight when tested during 10 min. at fuel pressure downstream of the unit (and before the burners) being 90-95 kg/cm², with the afterburner valve on, and fuel pressure at unit inlet being 2.6-2.8 kg/cm².

IX. PROCESSING AND DEPROCESSING ENGINE UNITS WHEN NOT INSTALLED ON ENGINE

1. Processing Units

All the units inactivated for more than 24 hours should be subjected to internal and external slushing.

For inner slushing use non-contaminated oil, grade MK-8, dehydrated at a temperature of 110-120°C, or transformer oil.

Oil is delivered into the unit preheated to 50-70°C.

Apply anti-corrosive compound to all outer surfaces not protected with paint coating.

For outer slushing employ general purpose lubricant, grade VH or gun grease heated to 65-75°C and applied evenly to the surfaces. The thickness of the layer should not exceed 0.5 mm.

Wash the surfaces to be treated with anti-corrosive compound with dehydrated non-contaminated gasoline. Check to see that all pipe unions and lead-outs are capped.

Inner Slushing of HP-10A Unit

All the unit cavities except those of the electric contactor and membrane cavities of the acceleration and starting control units should be treated with anti-corrosive compound.

Before slushing drain the fuel from the unit and wash the fuel filter of the fuel feeding pipe connection.

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Prior to delivering oil check to see that all holes except the fuel outlet pipe union are fitted with protective caps.

Oil for anti-corrosive treatment is delivered into the unit through a fuel feed pipe connection at 0.5-1 kg/cm² pressure. Simultaneously the pump rotor is turned by the shaft splined shank until oil starts flowing intensively from the fuel outlet pipe union.

Anti-corrosive treatment completed, drain the excessive oil through the fuel feed pipe connection and cap the fuel outlet pipe unions and fuel feed pipe connection.

Note: When slushing the unit shift the control lever several times from the CUT-OFF (ОСТАНОВ) stop to FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop and backwards.

Inner Slushing of HP-11A Unit

All the inner cavities of the unit except those of the an-roid and the electric contactor should be subjected to slushing.

Before processing drain the fuel from the unit and wash the fuel filter of the fuel feed pipe connection.

Prior to feeding lubricant into the unit put protective caps on the unit holes except the fuel outlet pipe union.

The anti-corrosive compound is fed into the unit through the fuel feed pipe connection at 0.2-3 kg/cm² pressure with the electromagnet energized. Bleed the air from the unit through the air relief valve.

Slushing is carried out with the rotor speed of $n = 250 - 500$ r.p.m. If the unit is slushed on the stand it is allowed to fit, at the rotor fuel outlet, a 1-2 mm dia. jet.

The anti-corrosive compound is fed until oil begins intensively running out of the unit-to-burners pipe union. After this the electromagnet should be energized and de-energized three times.

The processing over, drain excessive oil through the fuel feed pipe connection, then cap the fuel outlet pipe union and fuel feed pipe connection.

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2. Removal of Anti-Corrosive Compound

Prior to installation on the engine the interior of the units should not be deprocessed.

To remove anti-corrosive compound from the pump outer surfaces use a brush soaked in gasoline or blow the pump on a special stand with a mixture of gasoline and compressed air; it is also possible to wash out the anti-corrosive compound with a stream of oil heated not above 50°C.

Prior to removing the corrosion-preventive compound check to see that all pipe unions and lead-outs are plugged.

3. Storage of Parts, Assemblies, and Units

The processed parts, assemblies and units may be stored during one year under the conditions specified in these Instructions.

Upon expiration of the storage period the parts and assemblies should be deprocessed and treated for another period of storage, provided that no signs of corrosion appear on the parts.

To effect this proceed as follows:

(a) take 5 per cent of the units (but not less than two) from the stored quantity and subject them to complete disassembly fully removing the anti-corrosive coating.

(b) if no signs of corrosion are found, remove the anti-corrosive coating from all the units, wash them in clean gasoline and reprocess.

The premises for storage should be dry, clean and well ventilated, the temperature there maintained within 20±10°C.

The units are stored in cabinets or on racks wrapped in paraffin paper, all their openings being plugged.

The units in cabinets or on racks should be placed at intervals providing for free access to each unit.

When storing the units see that no mechanical damage is inflicted on their outer surfaces and projecting parts.

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Individual parts and accessories will not be wrapped when stored for not more than two days.

If the storing period exceeds two days wrap the parts in paraffin paper.

It is allowed to store similar parts and units in a common container.

If it is allowed to store units packed in special boxes together with a set of spare parts, provided that conditions specified in these Instructions are strictly observed.

4. Corrosion-Preventive Treatment of Units for Two-Year Storage

The units will be treated for stand-by storage in compliance with the present Instructions.

Do not drain the oil from units upon accomplishment of inner slushing.

The inner and outer corrosion-preventive treatment completed, wrap the units in paraffin paper and put them in a cardboard box, placing the latter in an organic film case coated with lubricant grade VH.

Two bags with silica gel and a reference desiccator are also placed in the case which is then glued. The unit packed in the case is placed into another cardboard box.

Anti-corrosive treatment completed, the units are packed in cases with specially provided ports to inspect the desiccator colour.

The units are inspected monthly during the whole storage period without removal of the protective film.

Should any changes in the colour of the desiccator be detected, cut off the seam, replace the desiccator and bags with silica gel.

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X. NEW DEVICES TO LOCK UNITS

Since 1956 plate locks have been introduced instead of wire locking. The following points are plate-locked in the HP-10A unit:

- the wobble plate pin cover, the pump body - to - rotor cover joint,
- the pump body - to - governor body joint,
- the distributing valve spring cover,
- the acceleration control unit casing,
- the starting control unit cover,
- the throttle valve pin sleeve,
- the switch cover, the control lever coupling bolt nut.

Plate-locked in the HP-11A unit are:

- the electromagnet, the barostat housing-to-pump body joint, the barostat valve housing - to - aneroid body joint,
- the rotor cavity cover - to - pump body joint, the diaphragm body cover, the aneroid cavity cover, the barostat valve cavity cover,
- the fuel valve cover, and the switch cover.

The remaining points are locked with wire as shown in Figs 34 and 36.

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XI. SINGLE SET OF SPARE PARTS FOR UNITS

No.	Part No.	Name of part	Quantity
1. HP-10A Unit			
1	90191	Gasket	1
2	90200	Packing ring	2
3	276247	Sealing ring	4
4	276325	Same	4
5	276388	Packing ring	2
6	370148	Bolt	1
7	2609C6-1,5-f	Packing ring	3
8	2609C8-2-f	Same	4
9	2609C10-2-f	Same	4
10	2609C11-1,5-f	Same	2
11	2609C12-1,5-f	Same	2
12	2609C12-2-f	Same	4
13	2609C14-2-f	Same	2
14	2609C15-1,5-f	Same	2
15	2609C16-2-f	Same	4
16	2609C18-2-f	Same	2
17	2609C22-2,5-f	Same	2
18	15A49-5	Spring washer	4
19	1x15 State Standard FOCT 397-54	Cotter pin	2
20	1,5x10 State Standard FOCT 397-54	Same	2
21	2x25 State Standard FOCT 397-54	Same	2

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No.	Part No.	Name of part	Quantity
2. HP-11A Unit			
22	90191	Gasket	1
23	90200	Packing ring	1
24	276247	Sealing ring	2
25	276338	Packing ring	1
26	312146	Gasket	2
27	2609C4-1,5-f	Packing ring	1
28	2609C6-1,5-f	Same	2
29	2609C7-1,5-f	Same	2
30	2609C8-2-f	Same	2
31	2609C12-2-f	Same	3
32	2609C14-2-f	Same	1
33	2609C16-2-f	Same	2
34	2609C18-2-f	Same	2
35	2609C25-2,5-f	Same	1

XII. PARTS OF FUEL SYSTEM UNITS

Part No.	Reference No. in Figs 11-21	Description	Quantity	Material
1	2	3	4	5
1. HP-10A Unit				
90.090		Wobble plate bearing pin with rubber packing spacers	2	
276.011A		Pump body with sleeve of wobble plate piston rod	1	
276.016A		Rotor with sleeves	1	
276.017A		Rotor with plungers and shaft	1	

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1	2	3	4	5
276.0235		Centrifugal weights fork	1	
276.043B		Wobble plate (bearing with body)	1	
276.061		Bracket with governor slide	1	
276.066	73	Unit pump fuel feed line filter	1	
279.042		Piston with wobble plate rod	1	
296.035	15	Wobble plate and return slide valve piston	2	
296.042	79	Throttling assembly filter	6	
296.047	124	Hydraulic decelerator piston	1	
311.033-1		Rotor splined bushing	1	
311.034	62	Rotor shank gland	3	
312.029-1		Switch KB-6, in assembly	1	
315.035A	151	Acceleration control unit adjusting screw	2	
315.050		Adjusting screw with contactor plug	1	
315.051		Distributing valve and sleeve	1	
315.057	157	Starting control unit valve	1	
315.058		Rod with starting control unit guide	1	

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1	2	3	4	5
315.063	149	Starting and acceleration control units membrane	1	
315.066		Idling rating valve adjusting head	1	
340.019		Support needle of transmitter slide valve	1	
351.004		Governor transmitter	1	
351.006		Pump cover, in assembly	1	
351.011A		Governor body with slide valves and throttle valve needle	1	
351.0125		Fuel distributor with slide valves and hydraulic decelerator rod	1	
351.018		Transmitter slide valve and cylinder	1	
351.020		Clutch with hydraulic decelerator spring guide	1	
351.021A		Hydraulic decelerator rod	1	
351.022		Damper	1	
351.023		Contactor housing with rod	1	
361.070		Governor filter	1	
361.018		Hydraulic decelerator adjusting limiter	1	

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1	2	3	4	5
374.013		Pump cover with vent duct plug	1	
374.014		Pump cover with roller bearing	1	
380.031		Air relief valve	1	
24HE/60-12		Throttling assembly ^a	1	
No. 24	42	Ball bearing	4	
2688136	56	Wobble plate radial-thrust bearing	1	
292.202	63	Rotor shank roller bearing	1	
36203E	45	Ball bearing	2	
KB-6	126	Switch	1	
8W-4		Plug	1	
2011		Name plate fastening pin	2	Wire, brass J62
2213		Lock balls spring	4	Wire, steel OBC
2411		Idling rating valve head retainer	2	Steel 1X13
2418		Head spring	2	Wire, 0.5 steel OBC
20013		Spring washer	2	Steel 50X4A
20048		Same	13	Steel 50X4A
20067		Same	2	Steel 50X4A
20072		Nut, 4 x 0.7	2	Steel 45
90107	13	Ported member dowel	2	Steel 45
90113	8	Plunger spring guide	7	Steel 50X4A

^a To be selected during adjustment.

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1	2	3	4	5
90119	9	Copper-graphite ball bearing lock ring	1	Bronze 5pKMU-3-1
90127-3	65	Wobble plate pin	2	Steel 12XH3A
90128	67	Pin packing ring	4	Rubber 4327
90129	68	Bearing body adjusting washer	2	Steel sets
90130	66	Wobble plate pins cover	2	Steel 20
90131		Fine cover gasket	2	Flexible textolite MA
90141	4	Pin of wobble plate piston rod	1	Steel 1X13
90191		Glands cover gasket	1	Flexible textolite MA
90200	71	Packing ring of fuel feed pipe connection	1	Rubber 4327
90207		Slide block of piston rod	1	Steel 1X15
90209		Adapter sleeve of adjusting screw for fuel feed pipe connection	4	Steel 45
90213		Gland cover attachment bolt	6	Steel 45
90239		Nut of contactor screw	1	Steel 45
90252-2		Casing for shipment of shaft	1	Steel 0.8 10mm or 20 mm
91109		Cap of contactor adjusting screw	1	Steel 45
147.117	48	Rotor bearing	1	Copper-graphite mixture MCN1W

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1	2	3	4	5
148.131	158	Spring of starting control unit valve	1	Wire 0.8, steel 50X4A
149.114		Damper spring	1	Wire 0.8, steel 08C
155.141	138	Adjusting screw of distributing valve spring	1	Steel 2X13
190.111		Packing ring of decelerator retainer screw	1	Rubber 4327
190.139-1		Dowel securing decelerator retainer screw	1	Steel 38XA
190.141-1	113	Locating sleeve	1	Steel 38XA
190.158-1	41	Centrifugal weights stop dowel	2	Steel 38XCA
190.167		Housings joint packing ring	2	Rubber 4327
190.169-1	35	Slotted washer	1	Steel 38XA
190.172		Throttle valve shaft packing ring	2	Rubber 4327
190.177	111	Adapter sleeve to be placed between two housings	1	Steel 1X13
190.178		Locating sleeve packing ring	4	Rubber 4327
190.179-2		Weight pin	2	Steel 12XH3A
190.192-1	78	Throttling assembly washer	3 sets, 150 pieces	Aluminium ADM
190.213		Weights bearing adjusting washer	4	Steel 45

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1	2	3	4	5
261.146		Starting and acceleration control units membrane shim	4	Membrane fibre TA-Mp
276.101A	1	Pump body	1	Aluminium alloy A99
276.107		Washer of rotor cavity cover	1	Paronite Y8-10
276.108		Pump - to - governor body joint washer	1	Paronite Y8-10
276.109A	10	Rotor	1	Steel 12XH3A
276.110	6	Rotor plunger bushing	7	Bronze B5-23
276.111	5	Plunger	7	Steel X8F
276.112	7	Plunger spring	7	Wire 1.4, steel 50X4A
276.113A	61	Rotor shaft	1	Steel 18XH8A
276.114-1	12	Rotor ported member	1	Bronze B5-23
276.115	11	Ported member lock	1	Bronze, beryllium 5p5-2
276.120 6	17	Piston sleeve	1	Steel X18
276.124		Fastening screw of rotor cavity cover	2	Steel 38XA
276.124-1		Same	2	Steel 38XA
276.126	58	Wobble plate minimum fuel delivery stop screw	1	Steel 12XH3A
276.130A	84	Throttle valve needle bushing	1	Steel 12XH3A

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1	2	3	4	5
276.141		Rack bushing	1	Bronze SpAMH10-4-4
276.143B	43	Centrifugal weightsfork	1	Steel 12XH3A
276.114B	47	Governor transmitter shaft	1	Steel 12XH3A
276.150	94	Throttle valve control shaft	1	Steel 12XH3A
276.158	140	Distributing valve spring seat	2	Steel 45
276.186-1	144	Distributing valve plunger bushing	1	Steel 12X13
276.187-1	143	Distributing valve plunger	1	Bronze SpAMH10-4-4
276.194		Lock of pistons and return slide valve	4	Steel 20
276.198A	18	Spring of return slide valve piston	1	Wire 3 2, steel 50XΦA
276.205		Plug of rotor cavity cover venting duct	1	Aluminium alloy 21T
276.225B	34	Return lever pin	1	Steel 1XH3A
276.226B	22	Return slide valve stop	1	Steel 12XH3A
276.229	99	Throttle valve sector	1	Steel 10X11
276.230A	83	Throttle valve needle	1	Bronze SpAMH10-4-4
276.231	16	Wobble plate piston spring	1	Wire 2.5, steel 50XΦA
276.232A	57	Wobble plate bearing housing	1	Steel 3W274

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1	2	3	4	5
276.239		Pipe connection for mea- suring fuel pressure at throttle valve inlet	1	Steel 45
276.254	27	Bearing ring of needle slide valve transmitter	2	Steel 1X15
276.255		Needle ball bearing cage	1	Bronze SpAMH10-3- -1.5
276.261		Contacting turn nipple	1	Steel 45
276.268		Distance ring	2	Steel 1X13
276.269		Locating bushing	3	Steel 1X13
276.270	95	Throttle valve shaft bushing	1	Steel 12XH3A
276.274		Transmitter slide valve spring seat	1	Steel 45
276.278	105	Constant pressure and constant pressure drop valves spring	2	Wire 1.3, steel 08C
276.286		Transmitter lever pin	1	Steel 12XH3A
276.289		Throttling assembly plug	3	Steel 45
276.295	125	Hydraulic decelerator piston spring	1	Wire 3.2, steel 50XΦA
276.296A	33	Return slide valve lever	1	Steel 13W274
276.297	23	Fork of return lever	1	Steel 12XH3A
276.298 A	137	Transmitter slide valve lever	1	Steel 3W274
276.299	31	Slide	1	Steel 4X14H1482W
276.300A	32	Bracket	1	Steel 3W274
276.302A	136	Same	1	Steel 3W274

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1	2	3	4	5
276.303	30	Slide pin	1	Steel 4X14H1482M
276.304-1	44	Transmitter bearings stop ring	1	Steel 65r
276.305		Locking plate of bearing bushing	1	Steel 20
276.306	46	Bearing coupling nut	1	Steel 45
276.307	72	Fuel inlet filter lock ring	1	Steel 65r
276.308		Return lever fork washer	1	Steel 38XA
276.3095		Transmitter bearing and fork distance washer	1	Steel 45
276.310		Fuel inlet filter upper case	1	Brass A62
276.311		Filter cone screen	1	Semitombak A30, screen No.016 B
276.312		Filter screen, inner	1	Semitombak A80, screen No.016 B
276.313		Same		Semitombak A80, screen No.2.5 B
276.314		Filter case, lower	1	Brass A62
276.315		Filter cone ring	1	Brass AC59-1
276.316		Filter cone cap	1	Brass A62
276.317		Filter cone case	1	Brass A62
276.318		Filter washer	1	Brass A62
276.319		Filter bracket	1	Brass A62
276.321	98	Stop screw of throttle valve control lever	2	Steel 12XH3A

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1	2	3	4	5
276.322A		Dowel securing shaft and weights fork	1	Steel 38XA
276.325		Packing ring of hydraul- ic decelerator stop screw	1	Copper M3
276.326	141	Distributing valve spring		Wire 3-5, steel 50XΦA
276.328		Packing ring of distri- buting valve bushing	1 set	Rubber 4327
276.328- -2.25		Sealing ring of distri- buting valve bushing	2	Rubber 4327
276.331	142	Distributing valve sleeve	1	Steel 45
276.334		Throttle valve lever cover plate	1	Steel 20
276.336 A	100	Limiter of throttle valve control lever	1	Steel 3H274
276.338	70	Fuel feed pipe connec- tion packing ring	1	Rubber 4327
276.340	93	Pipe union of cavity behind throttle valve and fuel vent pipe union	2	Steel 45
276.341		Fuel vent pipe union swivel nipple	1	Steel 45
276.343	146	Pipe union of burner main fuel manifold	1	Steel 45
276.344	145	Pipe union of burner primary fuel manifold	1	Steel 45

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1	2	3	4	5
276.347A	112	Blind nut of hydraulic decelerator adjusting stop locating bushing	1	Steel 45
276.350		Return lever bracket pin	1	Steel 12XH3A
276.353		Bracket pin washer	1	Steel 20
276.357		Locating bushing nut	1	Steel 45
279.123-1	2	Link connecting piston rod and wobble plate	1	Steel 12XH3A
279.129-1		Gland frame	3	Steel 20
279.130-1		Gland spring	3	Wire 0.3, steel 08C
279.134	59	Fuel vent ring	1	Aluminium alloy AlT
279.156	40	Transmitter slide valve support needle	2	Needle 2.5x14
279.185		Packing ring of wobble plate piston bushing	1	Rubber 4327
279.194	55	Shaft lock ring	1	Wire 1.8, steel 08C
279.255	14	Piston rod	1	Steel 1X13
279.257		Washer of return lever piston spring	1	Steel 45
279.262		Bushing of wobble plate piston rod	1	Bronze 8624
296.212	110	Plug of constant pressure and minimum pressure valves	2	Steel 45
296.229		Glands cover centring ring	1	Aluminium alloy AlT

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1	2	3	4	5
296.237		Piston washer	3	Steel 45
296.239	52	Wobble plate maximum delivery stop screw	1	Steel 12 XH3A
296.246		Hydraulic decelerator piston washer	1	Steel 45
296.248	74	Throttling assembly body	3	Steel 12XH3A
296.250		Dowel of hydraulic decelerator stop	2	Steel 38XA
296.269	75	Frame screen of throttling assembly filter	3	Semitombak, J80, screen No. 043B
296.270	76	Screen of throttling assembly filter	3	Screen, phosphorous bronze, No. 004B
296.271		Same	6	Screen, brass, No. 016B
297.242		Membrane of starting and acceleration control units	2	Fabric, rubberized, TD-MP
297.250		Membrane disc	2	Steel 12XH3A
297.401		Rivet fastening membrane disc	12	Steel 1X18H9T
302.109		Lock of pin connecting link and wobble plate and of return lever fork lock	2	Steel 20
311.131	81	Throttling assembly nut	3	Steel 45
311.134	80	Throttling assembly distance piece	3	Brass AC59-1

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1	2	3	4	5
311.154		Filter frame	6	Brass J62, soft
311.172	26	Spring of transmitter slide valve cylinder	1	Wire 1.5, steel OBC
311.187		Packing ring of rotor slotted bushing	1	Rubber 4327
311.206		Damper plug	1	Brass J659-1
311.208-1	49	Rotor splined bushing	1	Steel 12XH3A
311.209-1	50	Bushing plug	1	Steel 10
311.210		Washer of shaft gland	3	Steel 20
311.211	60	Shaft gland housing	1	Aluminium alloy AIT
311.213	104	Bushing of constant pressure drop valve	1	Steel 4X14H1482W
311.214	103	Constant pressure drop valve plunger	1	Steel 4X14H1482W
311.216	36	Transmitter slide valve cylinder bushing	1	Steel 4X14H14 82W
311.217	108	Constant pressure valve slide valve	1	Steel 4X14H1482W
311.218	109	Valve bushing	1	Steel 4X14H1482W
311.219	37	Transmitter slide valve cylinder	1	Steel 4X14H1482W
311.221	20	Return slide valve	1	Steel 4X14H1482W
311.222	19	Return slide valve bushing	1	Same
311.225		Jet	2	Brass J659-1

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1	2	3	4	5
311.226	107	Valve spring adjusting washer	2 (see)	Steel 20
311.228	3	Pin connecting piston link and wobble plate	1	Steel 12XH3A
311.229		Rotor splined bushing dowel	3	Steel 45
315.152	147	Acceleration control unit valve bushing	1	Steel 4X14H1482W
315.153	148	Acceleration control unit valve	1	Same
315.154		Acceleration and start- ing control units air feed pipe union	2	Steel 45
315.163		Switch lever pin	1	Steel 18 X
314.164	128	Switch lever	1	Steel 2X13
315.167	129	Maximum r.p.m. adjust- ing screw	1	Steel 2X13
315.168		Spring of maximum r.p.m. adjusting screw	1	Wire 1.5, steel OBC
315.170	132	Switch cover	1	Aluminium alloy AIT
315.172		Switch insulating plate	1	Textolite NT
315.177A		Acceleration and start- ing control units adjust- ing screw	2	Steel 2X13
315.192-1		Switch attachment screw	1	Steel 1X13
315.192-2		Same	1	Steel 1X13
315.215	130	Switch adjusting screw	1	Steel 1X13
315.216	131	Switch screw fork	1	Steel 1X13

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1	2	3	4	5
311.154		Filter frame	6	Brass A62, soft
311.172	26	Spring of transmitter slide valve cylinder	1	Wire 1.5, steel 08C
311.187		Packing ring or rotor slotted bushing	1	Rubber 4327
311.206		Damper plug	1	Brass AC59-1
311.208-1	49	Rotor splined bushing	1	Steel 12XH3A
311.209-1	50	Bushing plug	1	Steel 10
311.210		Washer of shaft gland	3	Steel 20
311.211	60	Shaft gland housing	1	Aluminium alloy 217
311.213	104	Bushing of constant pressure drop valve	1	Steel 4X14H1482M
311.214	103	Constant pressure drop valve plunger	1	Steel 4X14H1482M
311.216	36	Transmitter slide valve cylinder bushing	1	Steel 4X14H14 B2M
311.217	108	Constant pressure valve slide valve	1	Steel 4X14H1482M
311.218	109	Valve bushing	1	Steel 4X14H1482M
311.219	37	Transmitter slide valve cylinder	1	Steel 4X14H1482M
311.221	20	Return slide valve	1	Steel 4X14HMB2M
311.222	19	Return slide valve bushing	1	Same
311.225		Jet	2	Brass AC59-1

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1	2	3	4	5
311.226	107	Valve spring adjusting washer	2 (not)	Steel 20
311.228	3	Pin connecting piston link and wobble plate	1	Steel 12XH3A
311.229		Rotor splined bushing dowel	3	Steel 45
315.152	147	Acceleration control unit valve bushing	1	Steel 4X14H1482M
315.153	148	Acceleration control unit valve	1	Same
315.154		Acceleration and start- ing control units air feed pipe union	2	Steel 45
315.163		Switch lever pin	1	Steel 18 X
314.164	128	Switch lever	1	Steel 2X13
315.167	129	Maximum r.p.m. adjust- ing screw	1	Steel 2X13
315.168		Spring of maximum r.p.m. adjusting screw	1	Wire 1.3, steel 08C
315.170	132	Switch cover	1	Aluminium alloy 217
315.172		Switch insulating plate	1	Textolite NT
315.177A		Acceleration and start- ing control units adjust- ing screw	2	Steel 2X13
315.192-1		Switch attachment screw	1	Steel 1X13
315.192-2		Same	1	Steel 1X13
315.215	130	Switch adjusting screw	1	Steel 1X13
315.216	131	Switch screw fork	1	Steel 1X13

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1	2	3	4	5
315.217		Maximum r.p.m. adjusting screw cap	1	Steel 45
315.251	154	Starting control unit membrane spring	Set	Wire, steel OBC
315.252	159	Acceleration control unit valve seat	1	Steel 3X13
315.253		Starting control unit valve	1	Steel 3X13
315.254	156	Starting control unit valve rod	1	Steel 18X
315.255		Acceleration and starting control units spring support	2	Steel 3X13
315.256	155	Starting control unit valve rod guide	1	Bronze 6pANH10-4-4
315.268	133	Switch rod bushing	1	Steel 18X
315.272		Adjusting washer of hydraulic decelerator nut	Set	Steel 1X18H9-0H
315.274		Hydraulic decelerator rod stop	1	Steel 2X13
315.276		Membrane disc	2	Steel 12XH3A
315.277	153	Pipe union of starting and acceleration control units adjusting screw	2	Steel 2X13
315.278	152	Adjusting screw cap	2	Steel 45
315.285	89	Pipe union of idling rating valve screw	1	Steel 2X13
315.286	87	Adjusting screw of idling rating valve	1	Steel 2X13

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1	2	3	4	5
315.287		Spring ring of idling rating valve screw	1	Steel 65r
315.288	88	Pin of idling rating valve screw	1	Steel 1X13
315.289	90	Idling rating valve cap	1	Steel 1X13
315.290	86	Idling rating valve	1	Steel 2X13
317.107		Screw for plug fastening	4	Steel 25
326.101	101	Control lever	1	Steel 3M274
316.102	102	Adjusting eccentric of control lever	1	Aluminium alloy A17
326.103	69	Protecting cover of fuel feed cavity	1	Aluminium alloy A1A7
326.118	122	Rod bushing of hydraulic decelerator piston	1	Bronze 8524
340.143	24	Support of transmitter slide valve needle	1	Steel 3X15
340.144	25	Transmitter slide valve support needle	1	Steel 3M274
351.101	21	Governor body	1	Aluminium alloy A19
351.102E	121	Fuel distributor housing	1	Aluminium alloy A19
351.106	85	Idling rating valve bushing	1	Steel 18X
351.111	106	Plug of constant pressure drop valve spring	1	Steel 45
351.112	39	Centrifugal governor weight	2	Steel 12XH3A
351.114	28	Transmitter slide valve spring	1	Wire, steel 50X4A

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1	2	3	4	5
351.115		Packing ring of switch rod	Set	Rubber 4327
351.116		Stud of wobble plate pins cover	6	Steel 38XA
351.118		Fuel vent pipe union	2	Steel 45
351.119-05		Jet of hydraulic decelerator throttling assembly	1	Steel 1X13
351.119-08		Fuel return chamber by-pass jet	1	Steel 1X13
351.119-3.0		Starting control unit jet	1	Steel 1X13
351.122	38	Transmitter slide valve	1	Steel 4X14H14B2M
351.124A	119	Rod of hydraulic decelerator	1	Steel 2X13
351.125		Gasket sealing the joint of governor body and fuel distributor housing	1	Paronite YB-10
351.127	116	Hydraulic decelerator spring retainer	1	Steel 2X13
351.128	118	Coupling of hydraulic decelerator rod	1	Steel 18X
351.130	120	Hydraulic decelerator spring support	1	Steel 1X13
351.131	117	Hydraulic decelerator spring	1	Wire 2, steel 50XCA
351.133		Damper	1	Brass AC59-1
351.134	115	Rack bushing	1	Steel 38XA
351.135	160	Minimum pressure valve stop	1	Steel 1X13

* The stop is interchangeable with part 370140

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1	2	3	4	5
351.136		Switch cover-to-body joint sealing gasket	1	Paronite YB-10
351.137A	150	Acceleration control unit spring	1	Wire 2.2, steel 08C
351.138		Idling rating valve washer	Set	Steel 1X18H9-0H or H or H
351.139	134	Switch rod	1	Steel 18X
351.140	135	Nut of hydraulic decelerator piston rod	1	Steel 1X13
351.141	127	Switch housing	1	Aluminium alloy AIT
351.142		Idling rating valve washer	1	Bronze A-5p-52-M
351.146		Swivel nipple of fuel vent pipe union	1	Steel 45
351.147	97	Throttle valve shaft bushing	1	Bronze 5pA1H10-4-4
351.148		Plug of governor filter	1	Steel 45
351.150	161	Minimum pressure valve spring	1	Wire 1.6, steel 08C
351.151	162	Minimum pressure valve	1	Steel 4X14H14B2M
351.152	96	Rack of transmitter slide valve	1	Steel 12XH3A
361.110	114	Stop for adjusting r.p.m. of beginning of automatic operation	1	Steel 38XA
361.123		Spring securing governor filter	1	Wire 1.5, steel 50XCA

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1	2	3	4	5
361.125	170	Adjusting washer of governor filter	1 set	Steel 2X18H9-0H
361.506	168	Filtering screen	1	Screen No. 0043
361.507	167	Frame screen	1	Screen No. 04B
361.509	172	Spring	1	Wire, dia. 1.5, OBC
361.510		Filter washer	1	Steel 2X18H9-0H
361.511	171	Filter spring seat	1	Steel 1X13
361.512	169	Spring of filter valve	1	Wire 0.55 OBC
361.520	173	Filter ring	2	Pipe, brass, AC59-1
361.521	174	Stud	8	Wire OBC
361.522	165	Filter body	1	Bronze SpCYH6-2
370.130		Starting control unit jet plug	1	Steel 45
370.148		Cover of fuel feed cavity bolt	4	Steel 45
370.162	139	Distributing valve cover	1	Steel 45
372.116B	163	Minimum pressure valve bushing	1	Steel X18
374.104A	92	Swivel nipple of pipe union connecting cavity behind throttle valve	1	Steel 45
374.105	91	Pipe union bushing	1	Steel 45

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1	2	3	4	5
374.107	64	Pump cover	1	Aluminium alloy A/9
374.108		Air relief valve spring	1	Wire 0.8, steel 50X4A
374.109		Acceleration and starting control units cover	2	Aluminium alloy A/9
378.155	123	Hydraulic decelerator piston bushing	1	Steel 30X7CA
380.287		Air relief valve pipe union	1	Steel 1X13
380.288		Cap of air relief valve pipe union	1	Steel 45
3HK14x1.5		Protecting cap	6	Plastics K-18-2
3HK16x1.5		Same	1	Plastics K-18-2
3HK18x1.5		Same	2	Plastics K-18-2
5HK4		Nut	6	Steel 45
5HK5		Same	4	Steel 45
5HK6		Same	8	Steel 45
3HK22x1.5		Protecting cap	1	Plastics K-18-2
6HK6		Nut	11	Steel 45
10HK6x1		Blind nut	1	Steel 45
12HK8x1		Plug	3	Steel 45
12HK10x1		Same	2	Steel 45
12HK10x1.5		Same	1	Steel 45
12HK16x1.5		Same	3	Steel 45
12HK18x1.5		Same	1	Steel 45

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1	2	3	4	5
15A49-5		Spring washer	4	Steel 65r
20HK3.5		Plug	3	Aluminium alloy AIT
20HK4		Same	12	Aluminium alloy AIT
20HK5		Same	1	Aluminium alloy AIT
25HK-0.45	77	Jet	40	Steel 1X18H9-M
25HK-0.6	77	Same	40	Same
25HK-0.7	77	Same	40	Same
34HK6	51	Cap of wobble plate stop screws	3	Steel 45
35HK6	53	Nut or adjusting screws	3	Steel 45
213M51-3-8		Dowel	4	Steel 38XA
216M51-8x1		Nut	4	Steel 38XA
218M51-5		Same	2	Steel 38XA
218M51-6		Same	12	Steel 38XA
222M51-6		Castle nut	4	Steel 38XA
229M51-4-40		Stud	2	Steel 38XA
229M51-5-22		Same	5	Steel 38XA
229M51-6-26		Same	4	Steel 38XA
229M51-6-30		Same	11	Steel 38XA
229M51-6-34		Same	9	Steel 38XA
229M51-6-38		Same	1	Steel 38XA
229M51-6-46		Same	3	Steel 38XA
229M51-6-50		Same	1	Steel 38XA
229M51-6-65		Same	1	Steel 38XA

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1	2	3	4	5
234A50-0.5-3-6		Washer	4	Steel 20
234A50-0.5-4-7		Same	7	Steel 20
234A50-0.5-5-10		Same	13	Steel 20
234A50-0.5-6-10		Same	7	Steel 20
234A50-0.8-4-7		Same	1	Steel 20
234A50-0.8-4-8		Same	5	Steel 20
234A50-0.8-5-10		Same	22	Steel 20
234A50-1-6-12		Same	1	Steel 20
234A50-1-8-14		Same	1	Steel 20
234A50-1-8-12		Same	1	Steel 20
240M51-6-28		Bolt	1	Steel 38XA
562M47-6		Stop ring	1	Wire, steel OBC
564M50-12		Spring ring, flat	1	Steel 65r
130C51-6-62		Bolt	2	Steel 45
1406C51-4		Castle nut	3	Steel 45
1406C51-6		Same	2	Steel 45
1412C51-6		Same	1	Steel 30X7CA
1418C51-8		Same	1	Steel 45
2609C6-1.5r		Packing ring for auxiliary plugs	3	Rubber 4327
2609C7-1.5-r	54	Packing ring of adjusting screws	6	Rubber 4327
2609C8-2-r		Packing ring of piston rod damper, and plugs threaded 10 mm	9	Rubber 4327
2609C10-2-r		Packing ring of starting control unit valve seat fuel vent pipe unions	5	Rubber 4327
2609C11-1.5-r	32	Throttling assembly packing ring	6	Rubber 4327
2609C12-1.5-r		Packing ring of pipe union of cavity behind throttle valve	2	Rubber 4327

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1	2	3	4	5
2609C12- -2-f		Packing ring or acceleration and starting control units screw cap, and of fuel vent and air relief pipe unions	7	Rubber 4327
2609C14- -2-f		Packing ring of air relief pipe union cap and plug threaded 10 mm	3	Rubber 4327
2609C15- -1.5-f		Packing ring of plug and locating nut of hydraulic decelerator	2	Rubber 4327
2609C16- -2-f	164	Packing ring for plugs of constant pressure valve, minimum pressure valve, fuel outlet pipe unions, pressure measurement and idling rating valve pipe unions	6	Rubber 4327
2609C18- -2-f		Packing ring for constant pressure valve plug	2	Rubber 4327
2609C22- -2.5-f		Packing ring for start-ing control unit valve stem guide, for bushings of throttle valve shaft and cavity behind throttle valve	3	Rubber 4327
2609C28- -2.5-f		Packing ring for pipe unions of acceleration control unit and starting control unit	2	Rubber 4327
2609C28- -3-f		Packing ring for distributing valve cover	1	Rubber 4327

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1	2	3	4	5
2609C42- -2.5-f		Packing ring for switch body	1	Rubber 4327
2619C6- -1.5-f		Packing ring for idling rating valve screw shaft	2	Rubber 4327
2625C55- -12.5		Rubber gasket for protecting cap	1	Rubber 4061
2625C55- -14.5		Rubber gasket	1	Rubber 4061
2625C55- -16.5		Same	1	Rubber 4061
2625C55- -20.5		Same	1	Rubber 4061
H-2010		Bolt	12	Steel 45
H-2039		Same	1	Steel 45
H-4459		Round pin	1	Wire, steel OBC
H-6002		Plug	3	Steel 45
H-7504-1		Sealing ring	2	Aluminium alloy AJM
H-3103-1		Name plate	1	Tin, from No.35 or 42, class 1
H-9910		Seal	26	Aluminium AJM
II 5/32"N State Standard FOCT 3722-54	29	Ball of transmitter slide valve needle bearing	6	Steel Wx6
II 1/8"N State Standard FOCT 3722-54		Adjusting screw ball	6	Steel Wx6
IV 5/16"N State Standard FOCT 3722-54	166	Governor filter valve ball (modified to 3/16")		Steel Wx6

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1	2	3	4	5
IV 9/32"		Air relief valve ball	1	Steel Wx6
State				
Standard				
FOCT				
3722-54				
1x6 State		Cotter pin	1	Wire, steel
Standard				KC
FOCT				
397-54				
1x10 State		Same	3	Wire, steel
Standard				KC
FOCT				
397-54				
1x15 State		Same	1	Wire, steel
Standard				KC
FOCT				
397-54				
1.5x10		Same	4	Wire, steel
State				KC
Standard				
FOCT				
397-54				
1.5x15		Same	4	Wire, steel
State				KC
Standard				
FOCT 397-54				
2x25		Same	1	Wire, steel
State				KC
Standard				
FOCT				
397-54				
		Rubber	10g	Rubber 4327
		Same	15g	Rubber 3825
		Same	1.3g	Rubber 4327
		Safety wire, dia. 0.8	12m	Wire, brass #62
		Wire, dia. 0.35 mm	0.6m	Wire #70B
				OAA-505-005-52

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1	2	3	4	5
		Safety wire	0.4 m	Wire 0.8, steel KO
361.625	175	Filter body	1	Steel 3W274
361.626	176	Valve spring	1	Wire 0.5 steel 50x4A
361.096	177	Filtering disc	16-18	
361.627		Section disc	16-18	Brass #62
361.628		Ring	16-18	Brass #62
361.629		Filtering disc screen	32-36	Screen
				No. 0048
361.630		Frame screen	32-36	Screen
				No. 04B
361.631		Screen ring	32-36	Brass #62
361.632		Same	32-36	Brass #62
361.633	178	Washer	1	Steel
				2X18H9-PH
361.634		Bushing	1	Steel 3W274
64HK-8.5-12-0.5	180	Adjusting washer [*]	1	Steel 1X13
64HK-8.5-12-0.7		Adjusting washer [*]	1	Steel 1X13
64HK-8.5-12-1.5		Same	1	Steel 1X13
2: HP-11A Unit				
A-2	76	Aneroid	1	
91.011		Lever with barostat elastic partition	1	
91.018	56	Barostat elastic partition	1	

* to be selected during assembly

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1	2	3	4	5
91.022		Barostat air filter	1	
91.035		Diaphragm body with barostat gland	1	
276.066	27	Fuel inlet pump strainer	1	
279.034		Rotor with bushings	1	
296.042	79	Throttling assembly filter ^{xx}	2	Fig. 14
296.047	91	Afterburner valve piston	1	
303.013	30	Electromagnet valve	1	
311.021		Rotor with plungers	1	
311.033-1	24	Rotor slotted bushing	1	
311.034	13	Rotor shank gland	3	
312.015		Contacto body	1	
312.022		Contacto diaphragm	1	
312.024-1		Rotor cover	1	
312.025-1		Contacto cover with switch and plug	1	
312.026		Piston with rod	1	
312.027		Piston rod with link	1	
312.029-1	108	Switch KB-6	1	
317.011	133	Electromagnet coil	1	
318.C18		Diaphragm body with rod, slide and diaphragm	1	
336.005		Electromagnet	1	
336.013	135	Electromagnet panel	1	
336.014		Electromagnet body with cylinder	1	
361.065		Filter with screen ^{xx}	1	
361.070		High pressure fuel filter (in assembly) ^{xx}	1	
370.011E		Body with bushings, afterburner valve and valve units	1	

^{xx}Fig. 14. HP-10A Unit^{xx}Fig. 21. HP-10A Unit

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1	2	3	4	5
370.012A		Barostat valve housing	1	
370.013		Barostat aneroid body	1	
370.014A		Pump cover (in assembly)	1	
370.017A		Plug with cut-off valve rod	1	
370.018A	124	Cut-off valve seat	1	
370.022		Jet of servomechanism	Set	
370.023-1		Wobble plate (bearing with body)	1	
370.024/100	29	Electromagnet valve seat	1	
370.024/150		Barostat valve seat	1	
370.025A		Fuel valve	1	
370.026A		Damper	1	
380.031		Air relief valve	1	
24HK		Throttling assembly	Set	
70 through 150				
268.8136	19	Radial-thrust ball bearing of wobble plate	1	
292.202	16	Roller bearing of rotor shank	1	
WP16R23W5	136	Plug connector	1	
BU-4		Plug	1	
KB-6		Switch	1	
90.107		Pins securing bearing ring of rotor and slide valve	2	Steel 45
90.133		Packing ring	1	Rubber 4327
90.135	46	Piston cup expanding ring	1	Steel 38A
90.138		Lock	1	Brass A68
90.141	50	Piston rod pin	1	Steel IX13
90.191		Gland cover gasket	1	Textolite, flexible, MA
90.200		Packing ring of fuel feed pipe connection	1	Rubber 4327

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1	2	3	4	5
90.207		Piston rod slide	1	Steel WX15
90.209		Adapter sleeve	12	Steel 45
90.213		Gland cover bolt	6	Steel 45
90.239	79	Nut of barostat aneroid adjusting screws	2	Steel 45
90.242		Sealing ring of barostat air feed pipe union	1	Aluminium ALW
90.250-1		Protecting cap	2	Aluminium alloy 21T
90.252-2		Shaft protecting casing	1	Steel 0.8mm Steel 10 or 20
90.253		Name plate fastening bolt	2	Steel 45
90.264	45	Piston cup	1	Rubber 3825
90.265	42	Servopiston spring	1	Wire 2.5, steel 50X4A
90.266-1	43	Same	1	Wire 2.8, steel 50X4A
90.269	44	Piston	1	Steel 1X13
91.105	81	Filter bushing of aneroid cover	1	Brass AC59-1
91.106	82	Filter gauze	1	Semitombak A80 No.00718
91.109	78	Cap of barostat aneroid adjusting screws	2	Steel 45
91.111		Elastic partition plate	1	Bronze БрКМц3-1

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1	2	3	4	5
91.112-1	55	Barostat valve lever	1	Steel 25
91.113		Lever ring	1	Aluminium ALW
91.114	73	Diaphragm body rod limit	1	Steel 60Г
91.115		Stop nut	1	Steel 45
91.116		Stop lock	1	Aluminium ALW
91.117	68	Barostat valve	1	BK6 alloy
91.119	65	Valve seat lock	2	Aluminium ALW
91.120	69	Barostat valve spring seat	2	Steel WX15
91.124-1	62	Diaphragm body rod	1	Steel WX15
91.127	58	Barostat diaphragm	1	Rubber 4327
91.128-1	57	Barostat diaphragm body	1	Steel WX15
91.131		Gasket of aneroid cavity cover	1	Flexible textolite MA
91.132		Gasket of barostat valve cavity cover	1	Rubber 4004
91.135		Diaphragm body packing ring	2	Rubber 4327
91.146/100		Jet of electromagnet valve seat	1	BK6 alloy
91.146/150	67	Jet of barostat valve seat	1	BK6 alloy
91.151	71	Adjusting screw of barostat valve spring	1	Steel 12XH32
91.166	74	Gland of diaphragm body rod	1	Rubber 4327
91.167	75	Cap of rod gland	1	Brass A62
91.168	70	Barostat valve spring	1	Wire 2.33, steel, 50X4A

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1	2	3	4	5
93.127		Screw of wobble plate pins cover	8	Steel 45
147.115		Piston stop	1	Steel 38X1
147.116		Nut of piston stop	1	Steel 45
148.106	31	Packing ring of electromagnet	1	Rubber 4327
148.131		Spring of electromagnet valve	1	Wire 0.8, 50XΦA
155.141	111	Adjusting screw of fuel valve spring	1	Steel 2X13
190.192-1		Throttling assembly washer	96	Aluminium A4M
276.158	113	Retainer of fuel valve spring	2	Steel 45
276.194	96	Lock of afterburner valve cap	2	Steel 20
276.247		Sealing rings of barostat adjusting screws	4	Copper M3
276.258		Fuel vent pipe union	1	Steel 45
276.278	34	Constant pressure valve spring	1	Wire 1.3, steel 080
276.307	28	Fuel inlet strainer lock ring	1	Steel 65f
276.310		Fuel inlet strainer upper holder	1	Brass A62
276.311		Fuel inlet strainer cone screen	1	Semitombak A80 Screen No. 016
276.312		Fuel inlet strainer inner screen	1	Semitombak A80 Screen No. 016
276.313		Fuel inlet strainer outer screen	1	Semitombak A80, Screen No. 2.55

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1	2	3	4	5
276.314		Fuel inlet strainer lower holder	1	Brass A62
276.315		Fuel inlet strainer ring	1	Brass A62
276.316		Fuel inlet strainer cap	1	Brass A62
276.317		Fuel inlet strainer cone holder	1	Brass A62
276.318		Fuel inlet strainer washer	1	Brass A62
276.319		Fuel inlet strainer bracket	1	Brass A62
276.326	114	Fuel valve spring	1	Wire 3.5, steel 50XΦA
276.328-2.25		Packing ring of fuel valve bushing	2	Rubber 4327
276.328		Same	1	Same
276.331	115	Spring cup of fuel valve	1	Steel 45
276.338	71	Packing ring of fuel feed pipe connection*	1	Rubber 4327
276.340		Fuel vent pipe union	1	Steel 45
276.341		Swivel nipple of fuel vent pipe union	1	Steel 45
276.343	118	Pipe union feeding fuel to burners	1	Steel 45
279.107-1	2	Rotor roller bearing race	1	Steel 12X13A
279.112	5	Rotor lock ring	1	Steel 65f
279.114-4	12	Rotor shaft	1	Steel 18X16A
279.118	20	Wobble plate pin	2	Steel 12X13A
279.119		Packing ring of wobble plate pin	2	Rubber 4327

* FIG. 13. HP-10A Unit

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1	2	3	4	5
93.127		Screw of wobble plate pins cover	8	Steel 45
147.115		Piston stop	1	Steel 38X1
147.116		Nut of piston stop	1	Steel 45
148.106	31	Packing ring of electro-magnet	1	Rubber 4327
148.131		Spring of electromagnet valve	1	Wire 0.8, 50X4A
155.141	111	Adjusting screw of fuel valve spring	1	Steel 2X13
190.192-1		Throttling assembly washer	96	Aluminium Alum
276.158	113	Retainer of fuel valve spring	2	Steel 45
276.194	96	Lock of afterburner valve cap	2	Steel 20
276.247		Sealing rings of barostat adjusting screws	4	Copper M3
276.258		Fuel vent pipe union	1	Steel 45
276.278	34	Constant pressure valve spring	1	Wire 1.3, steel 080
276.307	28	Fuel inlet strainer lock ring	1	Steel 65Г
276.310		Fuel inlet strainer upper holder	1	Brass A62
276.311		Fuel inlet strainer cone screen	1	Semitombak A80 Screen No. 016
276.312		Fuel inlet strainer inner screen	1	Semitombak A80 Screen No. 016
276.313		Fuel inlet strainer outer screen	1	Semitombak A80, Screen No. 2.53

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1	2	3	4	5
276.314		Fuel inlet strainer lower holder	1	Brass A62
276.315		Fuel inlet strainer ring	1	Brass A62
276.316		Fuel inlet strainer cap	1	Brass A62
276.317		Fuel inlet strainer cone holder	1	Brass A62
276.318		Fuel inlet strainer washer	1	Brass A62
276.319		Fuel inlet strainer bracket	1	Brass A62
276.326	114	Fuel valve spring	1	Wire 3.5, steel 50X4A
276.328-2.25		Packing ring of fuel valve bushing	2	Rubber 4327
276.328		Same	1	Same
276.331	115	Spring cup of fuel valve	1	Steel 45
276.338	71	Packing ring of fuel feed pipe connection*	1	Rubber 4327
276.340		Fuel vent pipe union	1	Steel 45
276.341		Swivel nipple of fuel vent pipe union	1	Steel 45
276.343	118	Pipe union feeding fuel to burners	1	Steel 45
279.107-1	2	Rotor roller bearing race	1	Steel 12XH3A
279.112	5	Rotor lock ring	1	Steel 65Г
279.114-4	12	Rotor shaft	1	Steel 18XH8A
279.118	20	Wobble plate pin	2	Steel 12XH3A
279.119		Packing ring of wobble plate pin	2	Rubber 4327

* Fig. 13. HP-10A Unit

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1	2	3	4	5
279.123-1	51	Link of piston rod	1	Steel 12XH3A
279.129-1		Body of rotor shank gland	3	Steel 20
279.130-1		Gland spring	3	Wire 0.3, steel OBC
279.134	14	Vent ring of rotor shank gland	1	Aluminium alloy ANT
279.168	23	Adjusting washers of wobble plate	2	Steel 2X18H9-M
279.169	23	Same	4	Steel 2X18H9-OM
279.174A	9	Guide of plunger spring	9	Steel 50X4A
279.194	11	Shaft lock ring	1	Wire, steel OBC
279.214	6	Rotor	1	Steel 12XH3A MNTY-2353-49
287.342	54	Aneroid housing	1	Aluminium alloy A/9
287.343	83	Cover of aneroid housing cavity	1	Aluminium alloy AA9
287.361-1	77	Aneroid adjusting screw	1	Steel 2X13
287.364	41	Servopiston spring guide	1	Steel 2X13
287.365	85	Spring support of aneroid adjusting screw	1	Steel X18
296.212	32	Constant pressure valve plug	1	Steel 45
296.222		Packing ring of rotor slide valve	1	Rubber 4327
296.237		Piston wachor	1	Steel 45
296.248	74	Throttling assembly body ^m	1	Steel 12XH3A
296.249		Throttling assembly plug	1	Steel 38XA
296.269	75	Throttling assembly frame screen [*]	1	Semitonbac F30, screen No.04B

*Fig. 14. HP-10A Unit

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1	2	3	4	5
296.270	76	Throttling assembly filter screen ^m	1	Bronze, phosphor, No. 004B
296.271		Same	1	Screen, brass No. 016B
302.109		Lock connecting link and wobble plate	1	Steel 20
303.102	66	Valve seat sealing ring	2 sets	Brass M2
303.103		Electromagnet valve plate	1	BK6 or BK8 hard alloy
303.104		Valve disc	1	Steel 18XH3A
311.131	81	Throttling assembly nut ^m	1	Steel 45
311.134	80	Throttling assembly distance piece ^m	1	Brass AC59-1
311.154		Throttling assembly filter frame	1	Brass A62, soft
311.187		Packing ring of shaft bushing	1	Rubber 4327
311.196	8	Plunger	9	Steel X8F
311.197	10	Plunger spring	9	Wire 1.4, steel 50X4A
311.198	26	Slide valve	1	Bronze 85-23
311.199	7	Bushing of rotor plunger	9	Bronze 85-23
311.208-1		Shaft-bushing	1	Steel 12XH3A
311.209-1		Plug of shaft bushing	1	Steel 10

*Fig.14. HP-10A Unit

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1	2	3	4	5
311.210		Gland washer of rotor shank	3	Steel 20
311.218	36	Bushing of constant pressure valve	1	Steel 4X14H1482M
311.226	33	Spring shim of constant pressure valve	1 set	Steel 20
311.228	52	Pin connecting wobble plate and link	1	Steel 12XH3A
311.229	25	Shaft bushing pin	3	Steel 45
311.230	4	Rotor roller bearing cage	1	Aluminium alloy AIT
312.103-1	17	Rotor cavity cover	1	Aluminium alloy A19
312.104	101	Switch housing	1	Aluminium alloy AIT
312.105	109	Switch cover	1	Same
312.108		Gasket of rotor cavity cover	1	Paronite YB-10
312.113	110	Contacto diaphragm	1	Fabric T2-MF, rubberized
312.114		Diaphragm disc	1	Steel 45
312.115		Same	1	Steel 45
312.126	97	Afterburner valve cap	1	Steel 45
312.134		Cap of rotor cavity cover	1	Aluminium alloy AIT
312.136	105	Switch rod	1	Steel X13
312.137	103	Sleeve of switch rod	1	Steel X18
312.138	104	Spring of switch rod	1	Wire 1, steel 50X4A

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1	2	3	4	5
312.139	106	Spring support	1	Steel 45
312.140	48	Wobble plate piston rod	1	Steel 12XH3A
312.141	49	Piston rod bushing	1	Bronze 5pA#H10-4-4
312.144-1	22	Wobble plate pin cover	2	Steel 20
312.146	21	Cover gasket	2	Textolite, flexible, MA
312.147-1		Contacto switch insulating plate	1	Textolite NT
312.149		Rotor cavity cover screw	2	Steel 38XA
312.149-1		Same	2	Steel 38XA
312.150		Contacto switch screw	2	Steel 45
312.158		Gasket sealing contactor housing-to-cover joint	1 set	Textolite MA, flexible
312.162	100	Spring washer of afterburner valve piston	1	Steel 1X18H9-H
312.163	92	Spring support of afterburner valve piston	1	Steel 2X13
312.164	116	Fuel valve plunger	1	Bronze 5pA#H10-4-4
312.174A	18	Wobble plate bearing body	1	Steel 3H274
317.105	138	Electromagnet cylinder screw	1	Steel 45
317.107		Screw fastening plug connector to electromagnet	8	Steel 25
318.123	59	Diaphragm body block	Set	Steel 3X15
318.124	60	Slide ring	Set	Steel 3X15
321.123	80	Barostat air feed pipe union	1	Steel 45

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1	2	3	4	5
321.136		Bushing of diaphragm body-to-barostat-cover joint	1	Steel 45
321.137	61	Diaphragm body cover	1	Steel IX13
324.164	15	Gland housing of rotor shank	1	Aluminium alloy AIT
326.103		Protecting cap of fuel feed cavity	1	Aluminium alloy AIT
336.113		Electromagnet panel	1	Steel 10
336.114	128	Adjusting washer of electromagnet pole	Set	Steel 2X18H9-CH
351.119-06		Fuel outlet jet of fuel by-pass valve spring cavity	1	Steel IX13
351.119-1.0	40	Fuel feed jet of barostat valve	1	Steel IX13
351.148		Filter plug	1	Steel 45
360.213		Plug of afterburner valve cavity	1	Steel IX13
361.123		Filter spring	1	Wire 1.5, steel OBC
361.125	170	Adjusting washer of valve ball spring ^m	1 set	Steel 2X18H9-CH
361.506	168	Outer filter screen ^m	1	Screen No.004B
361.507	167	Filter frame screen ^m	1	Screen No. 04B
361.509	172	Filter spring ^m	1	Wire, dia.1.5, OBC
361.510		Filter spring washer ¹	1	Steel 2X18H9-CH

Fig. 21. HP-10A Unit

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1	2	3	4	5
361.511	171	Filter spring seat ^m	1	Steel 1X13
361.512	169	Ball type valve spring ^m	1	Wire 0.55, OBC
361.520	173	Filter ring ^m	2	Pipe, brass, AC59-1
361.521	174	Filter stud	8	Wire OBC
361.522	165	Filter body ^m	1	Bronze SpCYH6-2
370.1015	1	Pump housing	1	Aluminium alloy A/9
370.102-1	63	Barostat housing	1	Aluminium alloy A/9
370.110-1	119	Plug of cut-off valve rod	1	Steel 1X13
370.111		Cut-off valve seat	1	Steel 2X13
370.112A	120	Sleeve of cut-off valve rod	1	Steel 1X18
370.113A	123	Cut-off valve spring	2	Wire 1.6, steel, 50X4A
370.115	122	Adjusting washer of cut-off valve spring	2	Brass A62
370.116A	88	Damper	1	Brass AC59-1
370.1175	87	Damper sleeve	1	Steel 2X13
370.124	47	Wobble plate piston sleeve	1	30 XFGA
370.125		Barostat stud	2	Steel 38XA
370.126-1		Same	1	Steel 38XA
370.126-2		Same	2	Steel 38XA

Fig. 21. HP-10A Unit

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1	2	3	4	5
370.128		Swivel nipple for fuel venting from rotor chamber	1	Steel 45
370.129		Nipple clamp	1	Steel 45
370.130		Jet plug	2	Steel 45
370.131		Afterburner valve cavity cover	1	Steel 45
370.132A	98	Afterburner valve piston sleeve	1	Steel 30XГСА
370.134 B	90	Afterburner valve	1	Bronze 6pA#H10-4-4
370.135	89	Afterburner valve sleeve	1	Steel X18
370.137		Gland ring of rotor shank	1	Aluminium alloy AIT
370.140	142	Fuel by-pass valve stop	1	Steel 1X13
370.141		Servomechanism jet	Set	Steel 1X13
370.142		Same	Set	Steel 1X13
370.144	139	Fuel by-pass valve plunger	1	Bronze 6pA#H10-4-4
370.145	141	Spring of fuel by-pass valve	1	Wire 1.6, steel OBC
370.146	140	Plunger sleeve of fuel by-pass valve	1	Steel X18
370.147	143	Plug of fuel by-pass valve	1	Steel 45
370.148		Fuel delivery cavity cover bolt	4	Steel 45
370.149		Barostat stud	3	Steel 30XГСА
370.151	86	Barostat lever stop screw	1	Steel 12XH3A

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1	2	3	4	5
370.152	64	Barostat valve seat	2	Steel 12XH3A
370.153	121	Cut-off valve rod	1	Steel IX13
370.154	35	Constant pressure valve plunger	1	Steel 4X14H1482M
370.155A	117	Fuel valve sleeve	1	Steel 2X13
370.157		Jet plug	1	Steel 45
370.158	99	Afterburner valve piston spring	1	Wire 4, steel 50XΦA
370.159	72	Barostat valve cavity cover	1	Aluminium alloy AIT
370.160	95	Adjusting washer of afterburner valve piston	1 set	Steel 20
370.161		Electromagnet attachment bolt	6	Steel 45
370.162	112	Fuel valve cover	1	Steel 45
370.164	37	Wobble plate maximum fuel delivery stop screw	1	Steel 12XH3A
374.108		Spring of air relief valve	1	Wire 0.8, steel 50XΦA
380.287	126	Pipe union of air relief valve	1	Steel 1X13
380.288		Cap of air relief valve pipe union	1	Steel 45
0-27638		Electromagnet gasket	as required	Electric card-board 38, insulating
398235	127	Electromagnet body	1	Steel 10
3-98239		Pin	1	Steel Y10A, silver, 3rd class

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1	2	3	4	5
3-98240	134	Core	1	Steel 3
3-98241		Coil frame	1	Plastics
				K-21-22
3-98245-1	129	Electromagnet pole	1	Steel 10
3-98246	130	Electromagnet cylinder	1	Brass JCSJ-1
3-98247-2	131	Electromagnet rod	1	Bronze 60Sn7, beryllium
3-98249	137	Electromagnet cylinder fastening nut	1	Brass JCSJ-1
3-98250	132	Electromagnet packing ring	1	Rubber 4327
3HK14x1.5		Protecting cap	1	Plastics
				K-18-2
3HK16x1.5		Protecting cap	1	Plastics
				K-18-2
3HK18x1.5		Same	1	Plastics K-18-2
3HK22x1.5		Same	1	Same
5HK6		Nut	8	Steel 45
6HK5		Same	20	Steel 45
6HK6		Same	9	Steel 45
12HK3x1		Plug	3	Steel 45
12HK14x1.5		Same	1	Steel 45
14HK3x1.25		Barostat-to-pump body joint packing ring	2	Rubber compound 4327
20HK3		Plug	1	Aluminium alloy 11T
20HK4		Same	14	Same
20HK6		Same	1	Same
25HK-0.6		Jet	44	Steel IX18-R9-M
25HK-0.7		Same	38	Same
34HK6	39	Cap of adjusting screws	4	Steel 45
35HK6	38	Nut of adjusting screws	4	Steel 45

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1	2	3	4	5
39HK7-6-46	53	Wobble plate minimum fuel delivery stop screw	1	Steel 12XH3A
15A 49-3		Spring washer	1	Steel 65F
216W51-8x1	94	Nut	1	Steel 38XA
218W51-5		Same	7	Same
222W51-6		Castle nut	4	Steel 38XA
229W51-5-22		Stud	5	Steel 38XA
229W51-5-24		Same	12	Same
229W51-5-26		Same	2	Same
229W51-5-28		Same	2	Same
229W51-6-36		Same	4	Same
229W51-6-46		Same	3	Same
229W51-6-48		Same	3	Same
234A50-0.5-3-6		Washer	4	Same
234A50-1.5-3-8		Washer	8	Steel 20
234A50-0.3-4.7		Same	1	Steel 20
234A50-0.5-5-8		Same	6	Steel 20
234A50-0.8-5-8		Same	6	Steel 20
234A50-0.8-5-10		Same	7	Same
234A50-0.5-6-10		Same	25	Same
234A50-1.6-12		Same	5	Same
23A50-5		Safety washer	17	Same
564W50-12	107	Spring ring, flat	6	Same
564W50-30		Same	2	Steel 65F
129IC50-0.8-11-19	84	Spring	1	Steel 65F
130IC51-6-72		Bolt	1	Wire 0.8, steel 08C
1406C51-6		Castle nut	2	Steel 45
			2	Steel 45

1	2	3	4	5
1400J51-8		Castle nut	1	Steel 45
1811051-8		Same	1	Steel 30XPCA
2012A50-2-7		Rivet	1	Copper M2
2609C6-1.5-7		Packing ring for jet plugs, damper and auxiliary plug of constant pressure valve	6	Rubber 4327
2609C-1.5-7		Packing ring of adjusting screws	8	Rubber 4327
2609C8-2-7		Packing ring of jet plug and contactor pipe union	3	Rubber 4327
2609C11-1.5-7		Throttling assembly packing ring	2	Rubber 4327
2609C12-2-7		Packing ring of cut-off and air relief valves, fuel vent and fuel outlet pipe unions	7	Rubber 4327
2609C14-2-7		Packing ring of after-burner valve cover and air outlet pipe union	2	Rubber 4327
2609C16-2-7		Packing ring of fuel outlet pipe union and plugs of constant pressure and fuel by-pass valves	3	Rubber 4327
2609C18-2-7		Packing ring of filter and cut-off valve plugs	2	Rubber 4327
2609C25-25-7		Packing ring of after-burner valve plug	1	Rubber 4327
2609C42-25-7		Packing ring of contactor housing	1	Rubber 4327

1	2	3	4	5
2619C4.5-1.5-7		Packing ring of barostat and diaphragm body joint bushing	2	Rubber 4327
2609C52-8-2-7	93	Packing ring of after-burner valve piston	1	Rubber 4327
2619C28-3-7		Packing ring of fuel valve cover	1	Rubber 4327
2625C55-20.5		Gasket for protecting cap	1	Rubber 4061
2625C55-16.5		Same	1	Same
2625C55-14.5		Same	1	Same
M-6002		Plug	1	Steel 45
M-9103-1		Name plate	1	Tin plate C No. 35 or 42, 1 class
M-9910		Seal	12	Aluminium alloy ANW
2625C55-12.5		Gasket for protecting cap	1	Rubber 4061
1.5x10		Cotter pin	1	Wire KC, steel
State Standard FOCT 397-54				
1.5x15		Same	4	Wire KC, steel
State Standard FOCT 397-54				

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1	2	3	4	5
1.5x25 State Standard FOCT 397-54		Cotter pin	1	Wire KC, steel
IV 9/32"n State Standard FOCT 3722-54	125	Ball	1	Steel Wx6
IV 5/16"n State Standard FOCT 3722-54	166	Same	1	Steel Wx6
	3	Roller, 6x10	30	Steel Wx6
		Safety wire	10m.	Wire, brass, dia. 0.8
		Same	0.4m.	Wire KO, 0.8, steel
		Assembly wire, 0.35 mm ²	0.3m.	Wire MFWB 8Ty M3N
		Winding	3180 turns	Wire N38-2
		Assembly wire, 0.2 mm ²	0.6m.	Wire MFWB
		Insulation, 270x24x0.15	1	Varnished cloth AW2
		Tube, inner dia. 2mm	1	Vinylchloride

HP-10 AKC AND HP-11BA UNITS

XIII. GENERAL

The HP-10AKC and HP-11BA units manufactured since December 1956, are modified versions of the HP-10A and HP-11A units.

The HP-10AKC unit (Figs 36 and 37) is designed to automatically regulate the operation of the PA-95 turbojet engine main fuel system and to feed this system with fuel.

The unit comprises a high pressure variable displacement plunger pump, an automatic variable speed governor and a hydraulic decelerator, an acceleration control unit, a starting control unit, a throttle valve with a control mechanism, a constant pressure drop valve, a constant pressure valve, an idling rating valve, a distributing valve, a minimum pressure valve, a fuel by-pass valve, and an interlocking limit switch of the hydraulic decelerator.

Unit HP-10AKC, as distinguished from the HP-10A unit, has a fuel by-pass valve designed to decrease fuel delivery to ensure the engine reliable operation when cannon or rockets are being fired.

Rocket firing may cause abnormal operation of a turbo-jet engine: compressor surge and flame-out in the combustion chamber and in the afterburner.

The engine develops these troubles because a large mass of inert powder gases enters into the combustion chamber at high temperature thus decreasing the percentage of oxygen and amount of air consumed by the engine. As a result the flame dies out and the engine stalls.

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The HP-11BA unit (Figs 38 and 39) is designed to control automatically the fuel delivery into the afterburner system of the P-95 turbojet engine. The unit comprises a high pressure variable displacement plunger pump, an afterburner governor, a barostat type fuel consumption limiter, an afterburner valve, a cut-off valve, a fuel valve, an electromagnetic switch, a constant pressure valve, a fuel by-pass valve, and an interlocking device switch.

The HP-11BA unit, as distinguished from the HP-11A unit, is fitted with an afterburner control, which regulates fuel delivery into the afterburner so as to maintain a constant pressure drop of gases across the turbine.

The afterburner control is designed to regulate automatically fuel delivery into the afterburner depending on altitude and speed of flight.

XIV. BASIC SPECIFICATIONS

The basic specifications of the HP-10 AKC unit are similar to those of the HP-10A unit, while the basic data of the HP-11BA unit are similar to those of the HP-11A unit excepting the number of plungers (there are seven plungers in the HP-11BA unit).

XV. HP-10 AKC UNIT, PRINCIPLE OF OPERATION

The operating principle of the HP-10AKC unit is similar to that of the HP-10A unit, described above.

The only difference between the HP-10A and HP-10AKC units lies in that the latter incorporates a fuel by-pass valve. Fig. 40 illustrates a Key diagram of the HP-10AKC unit.

By-pass valve 12 is designed to decrease fuel delivery when electromagnet 11 is cut in.

As is seen from Fig. 40 the by-pass valve is inoperative. In this case the HP-10 AKC unit operates exactly in the same way as the HP-10A unit.

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After the circuit of electromagnet 11 is closed by-pass valve 12 shifts to the right and opens the ducts connecting decelerator servopiston cavity "a" and spring recess "d" of constant pressure drop valve 13 with the return line.

As a result servopiston 20 of the decelerator acted upon by spring 21 shifts to the left and readjusts (through lever 25) the spring tension of transmitter 26 from maximum r.p.m. to r.p.m. of beginning of automatic operation. Simultaneously the constant pressure drop valve shifts towards the spring, by-passes the high pressure fuel under servopiston 2 of the wobble plate into chamber "a", and makes fuel leave chamber "r".

As a result, servopiston 2 pushes wobble plate 5 to the minimum fuel delivery setting, thus decreasing sharply fuel delivery till fuel consumption is governed by adjustment of minimum pressure valve 29.

After electromagnet valve 11 is deenergized, fuel ceases flowing from constant pressure drop valve cavity "d" and hydraulic decelerator cavity "a", and the governor continues operating as before. The hydraulic decelerator resets the governor operation at initial rating. The decelerator throttling assembly 22 provides for smoothness of governor operation and ensures necessary smoothness when the engine is gaining the required rating.

XVI. HP-11BA UNIT, PRINCIPLE OF OPERATION

The key diagram of the HP-11BA unit is shown in Fig. 41.

Installed at the unit inlet is a protective filter, through which fuel is admitted into the low pressure cavity to slide valve 3 of rotor 6 whence the pumping unit transfers the fuel into high pressure pipe line "a".

The operating principle of the plunger pump is similar to that of the HP-11A unit (described above).

The position of wobble plate 5, fuel pressure and pump r.p.m. determine the pump output. The greater the tilt of wobble plate 5, the longer is plunger 4 travel and the greater the pump output.

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Servopiston 2, whose rod is hinged to the wobble plate bearing body, shifts wobble plate 5.

Servopiston 2 is controlled by the afterburner governor which changes the amount of fuel sent to the afterburner fuel nozzles in case balance between pressures P_2 and P_4 is disturbed.

By P_2 is meant corrected pressure of air after the compressor; P_4 stands for pressure of gases after the turbine (in the afterburner).

Servopiston 2 is controlled as follows.

With afterburner valve 36 open (shifted to the right) groove M is closed.

Cavity "d" of servopiston 2 connects the high pressure pipe line through a duct. Cavity "a" of servopiston 2 connects the high pressure pipe line via by-pass jet 45 and damper 44. Ducts (through damper 44) connect cavity "a" with barostat valve 14, with groove "m" on the afterburner valve, and with afterburner governor valve 13.

With barostat valve 14 closed and groove "m" overlapped, fuel consumption changes depending on the P_2 - P_4 pressure difference.

When afterburner governor valve 13 is closed fuel is no longer by-passed into the high pressure pipe line and pressure in chambers "a" and "d" is equalized.

Servopiston 2, acted upon by springs and P_2 - P_4 pressure difference, shifts wobble plate 5 so that the latter assumes its maximum tilt, thus ensuring the pump maximum output.

The maximum angle of tilt of wobble plate 5 is adjusted by maximum delivery screw 9.

When afterburner governor valve 13 opens, pressure in chamber "a" begins decreasing as fuel starts flowing out of the chamber. Servopiston 2 acted upon by excessive fuel pressure in chamber "d" overcomes the strength of springs 46, shifts towards chamber "a" decreasing the angle of tilt of wobble plate 5, and, consequently, the pump output. The fuel consumption will be changing until pressure P_4 in the afterburner manifold is equal to pressure P_2 and the whole system (engine-TR-11B1 unit) is brought to equilibrium. In this case the effects exerted on servopiston 2 from the left

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(by the wobble plate and by fuel in chamber "d") and from the right (pressure of fuel in chamber "a" and tension of springs 46) will be equal. Thus, the amount of fuel delivered by the pump is adjusted through changing the amount of fuel by-passed via afterburner governor valve 13 from chamber "a".

The amount of fuel by-passed from chamber "a" is controlled automatically by varying clearance between the seat and valve 13 of afterburner governor which equalizes pressures P_2 and P_4 depending on the flight speed and altitude.

The afterburner governor is designed to automatically regulate the amount of fuel fed to the engine (when the afterburner is switched on) with variations in flight speed and altitude.

The afterburner governor incorporates three chambers "r", "a" and "m". An elastic partition positioned between chambers "r" and "m" seals governor lever 10. Chambers "r" and "a" are separated by membrane 12. A pin with ball bearings acts as a supporting point of lever 10. The balance of this lever and, consequently, the equilibrium within the whole system depends on the correlation of the following factors: the forces of springs located over and under membrane 12 (when the unit is inoperative these springs hold the governor lever in balance), the pressure in channel "e" which acts on afterburner governor valve 13, and the difference between pressures P_2 and P_4 .

When gaining altitude fuel consumption is controlled as follows: the air pressure after the compressor, and, consequently, pressure P_2 starts dropping and membrane 12 will take up excess pressure ($P_4 - P_2$). As a result, the membrane will shift lever 10 and partially open afterburner governor valve 13, thus increasing flow of fuel from chamber "a" of servopiston 2. The latter will shift towards chamber "a" with resultant decrease of fuel delivery.

As less fuel is admitted into the engine afterburner, pressure P_4 begins decreasing. Fuel consumption will be decreasing until pressures P_2 and P_4 are balanced.

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The altitude barostatic control in conjunction with fuel valve 42 regulates fuel consumption with variations in the flight speed and altitude according to predetermined altitude characteristics. These characteristics are rated for somewhat excessive fuel consumption in the afterburner.

The barostatic control has two chambers "a" and "m" separated by an elastic partition which seals barostat lever 18. The balance of barostat lever 18 and, consequently, the balance of the whole system depend on the following forces: barostat valve spring 15, pressure in channel "e" on barostat valve 14, pressure in line "s" on transmitter block 21 and influence of aneroid 19. A change in any of the above mentioned forces inevitably calls forth a corresponding change in the co-acting forces (so as to restore balance). Practically speaking only pressure p_1 , acting on aneroid 19 and pressure in line "s" acting on transmitter 21 are interdependent.

Air pressure in barostat chamber "m" decreases with altitude. Aneroid 19 strives to expand and exerts increased pressure on the end of lever 18 relieving spring 15 of the barostat valve. As a result, fuel flow from chamber "a" of the wobble plate servopiston through barostat valve 14 increases. Servopiston 2 shifts towards decrease or pump fuel delivery. This will bring about decrease of fuel pressure in the system and before the membrane of transmitter 22. As a result the barostat parts will be rebalanced and a decreased pressure (as compared to ground conditions) will be maintained in line "s".

The law of pressure variations in line "s" with flight speed and altitude is determined by characteristics of aneroid 19, the diameter of block 21 of the transmitter (22) membrane and by variations in the arm length from the eccentric rod-to-micrometric screw 17 of barostat lever point to the attachment point of lever 18. Fuel flowing from line "s" to barostat transmitter block 21 passes through damper 23 which eliminates fuel pulsation originating in the system.

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The barostat is adjusted in compliance with the specifications by means of adjusting screw 16, spring 15 of valve 14 and aneroid screw 20.

The variations of maximum fuel consumption in the afterburner system (according to pressure in line "s") depend on the profile varying clear opening of fuel valve 42, as well as on tightening and tension of spring 40. Since pressure in line "s" is the function of pressure p_1 , maximum fuel consumption in the afterburner system (as referred to pressure p_1) depends on the adjustment of the barostat and the fuel valve.

Afterburner valve 36 controls fuel delivery into the afterburner system. The valve is connected with servopiston 37. Being energized, electromagnet 30 closes valve 29 and fuel from channel "x" flows into chamber "a" via throttling assembly 27, shifts the piston, opens valve 36, and compresses the spring. When the afterburner valve starts travelling, its groove "m" gets cut off and fuel flow from spring chamber "a" of the wobble plate rod servopiston ceases. Servopiston 2 starts pushing wobble plate 5 towards increase of fuel delivery. When the current is cut off, valve 29, loaded by spring 28 opens. Strong spring 35 of the afterburner valve servopiston forces fuel out of chamber "a" into the return line and closes afterburner valve 36.

Variations in fuel delivery during opening of the afterburner valve depend on changes of the inner dia. of the afterburner valve through section and on fuel pressure changes in line "s". The time during which pressure increases in line "s" is determined by the speed of wobble plate 2 servopiston travel. This speed depends on the capacity of damper 44. At the end of its stroke (when the afterburner is fully ON), servopiston 37 of the afterburner valve presses (via rod 31) the lever with adjusting screw 33 and disconnects switch 34 of the engine interlocking device thus disconnecting one circuit and connecting the other.

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When servopiston 37 is travelling backwards, spring 35 of the afterburner valve returns rod 31 and switch 34 to the initial position.

The speed of the afterburner valve opening depends on the capacity of throttling assembly 27. Constant pressure valve 26 is designed to ensure constant speed of the afterburner valve stroke at all flight altitudes. The valve maintains constant pressure in channel "K" irrespective of fuel pressure variations before it (i.e. after fine filter 24). As pressure increases in channel "K", valve 26 shifts towards the spring and reduces or completely closes the clear opening of holes on the valve side surface. This will maintain the desired fuel pressure (adjusted by spring 25) in channel "K".

Fuel valve unit. With afterburner valve 36 open (the scheme gives it closed) fuel from line "b", having passed through the afterburner valve, is admitted into channel "H" to the fuel valve.

Fuel valve 42 consists of the valve proper and guide bushing 41 with a profiled port. The position of the slide valve relative to the bushing port determines the through section of the fuel valve unit. The slide valve travel depends on the fuel pressure before the valve and the force of spring 40.

As pressure upstream to valve 42 increases, the valve through section also increases. The initial spring tightening is adjusted by screw 39.

Cut-off valve 43 prevents fuel leakage to the afterburner nozzles when the afterburner is cut out.

By-pass valve 38 positioned before the afterburner valve is designed to relieve pressure overloads occurring when the afterburner valve is cut out.

With the afterburner cut in, valve 38 is closed as the pressure drop across valve 36 is small to overcome the tightening of the valve spring.

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XVII. CONSTRUCTION OF HP-10 AKC UNIT

The HP-10 AKC unit is similar in construction to the HP-10A unit, the only difference being that the former is provided with a fuel return valve.

Fig. 42 shows the valve construction and its connection with the unit. Fig. 47 gives the dimensional drawing of the HP-10 AKC unit and illustrates the location of the locking devices.

The fuel return valve consists of two units: the valve proper and the electromagnet.

The fuel return valve (Fig. 43) is housed in the governor body. It includes a bushing, a slide valve, a spring guide and a spring. Steel slide valve 12 travels inside steel bushing 13, pressed into governor body 1 with a 0.02 - 0.04 mm negative allowance. When matching the slide valve with the bushing a diametral clearance is observed within 0.005 - 0.008 mm. The mating surfaces should be carefully machined accurate within 0.003 mm. Three rows, each of seven 1.5 mm dia. holes, are drilled in bushing 13. Opposite each row of holes circular grooves are positioned in the governor body. A duct connects the lower groove with the fuel chamber of the hydraulic decelerator; the middle groove is connected with the low pressure chamber, while the upper one communicates with the constant pressure drop valve spring chamber.

Slide valve 12 has two wide bands. When the valve is in the OFF position, the slide valve bands close the lower and upper rows of holes in the bushing. When the valve is switched on, the slide valve sinks down and connects through its grooves the fuel cavity of the hydraulic decelerator and the spring chamber of the constant pressure drop valve with the return line.

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The upper portion of slide valve 12 has a spherical head, to which spring guide 14 is lapped, dimension M being 14_{-0.02} mm and C being 1^{+0.5}_{-0.1} mm.

To check whether the sizes of M and C have been chosen correctly a hydraulic test is carried out. The holes are considered to be opened by edges K at the moment when at $p = 10 \text{ kg/cm}^2$ fuel flow attains the rate of 3 - 5 cu. cm/min. To observe the rated size of M it is allowed to grind surface II of spring guide 14 to 0.3 mm and edges K of slide valve 12 to 0.2 mm. The slide valve travel is 3 mm.

Electromagnet 10 (9MKO-M) (See Fig.42) is an electromagnetic power device designed to operate on D.C., 22 - 27 V supply.

The electromagnet consists of the following main parts and units: armature 7, core 4, coil 5, rod 6, casing 3, nut 8 and adjusting screw 9.

The electromagnet is installed on the threaded portion of adapter 2, which is secured to governor body 1 by four screws. A rubber ring seals the joint between the adapter and the governor body. When the electromagnet is being adjusted armature 7 should be brought close to core 4 and clearance "a" should be set within 1_{-0.1} mm by the agency of screw 9.

After the armature travel on the unit has been adjusted, adjusting screw 9 should be centre-punched in three points.

Fuel is admitted into the spring chamber of the constant pressure drop valve through a damper with filter 11, specially designed in unit HP-10 AKC.

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XVIII. CONSTRUCTION OF HP-11BA UNIT

The HP-11BA unit comprises essentially the following main parts: the high pressure plunger pump, the afterburner governor, the barostatic flow control unit, the afterburner valve, the cut-off and fuel valves, the electromagnet switch, the constant pressure and fuel by-pass valves, and the electric switch of the interlocking device.

All the innumerable parts (with the exception of a new afterburner governor, a modified barostat and a modified electric switch of the interlocking device) are similar in construction to the respective parts of the HP-11A unit, described above. The construction and arrangement of the unit parts are shown in Figs 44 and 45. Fig. 48 gives the dimensional drawing of the HP-11BA unit, and illustrates the location of the locking devices.

Afterburner Governor

Fig.44 shows the construction of the afterburner governor assembly, which comprises the barostatic flow control unit.

The governor assembly consists of aneroid housing 49 and governor body 59, secured to each other by studs. The governor assembly is secured on the pump body to the flange of the wobble plate servopiston.

The barostatic flow control unit consists of an aneroid, a barostat lever, a fuel valve, a valve seat with a jet, adjusting screws and springs. Capsule type aneroid 48 with cones fitted on its both ends is encased in aneroid housing 49. One cone of the aneroid is accommodated in the recess of double arm lever 50 of the barostat, while the other cone is located on spring-loaded support 42 which is placed on the cylindrical portion of adjusting screw 44 in the middle of cover 47. Spring 43 presses the aneroid to the recess of lever 50.

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Air flowing into the aneroid chamber through pipe union 45 is cleaned when it flows through screen 46. One end of barostat lever 50 has a taper recess to receive a cone; pressed into the other end of the lever is stop 35 with two cones. The middle part of the lever has a boss with a hole bored there to receive two ball bearings 61 separated by spacer ring 62. The bearings are secured to the lever by centre-punching. The cylindrical groove of the lever mounts rubber cup 24 with holder 22 and washer 21. Nut 20 seals the joint between the cup and the lever.

Adjusting micrometric screw 41 is turned into the barostat lever between ball bearings 61 and stop 35. The barostat lever assembly is accommodated in the governor body on pin 60, the cylindrical shoulder of cup 24 entering the groove on the governor body end face. Washer 23, of appropriate thickness, ensures compression of the cup by 0.2 - 0.4 mm; thus the joint between the fuel cavity of the barostat valve and the air cavity of the aneroid housing is sealed.

The fuel valve of the barostat includes steel seat 31, of superhard alloy, with a metering orifice 30. The valve is screwed into governor body 59 and locked in place. The upper portion of the valve seat is machined flush with jet 30 and mounts valve 29, which is a round plate of superhard alloy (2 mm thick). The plate is welded in a steel cup with a taper recess for stop 35.

The clearance between valve seat 31 with the jet and valve 29 (prior to mounting spring 32 and aneroid 48) should be within 0.03 - 0.5 mm. The clearance is adjusted by selecting shims 34 of appropriate thickness (it is allowed to employ only one shim). After selecting a shim and carrying out a tightness check, the valve is secured by lock 33. Stop 38 in cover 39 limits the valve movement upwards. Lever 50 presses valve 29 to its seat by means of spring 37 placed on cone guides 36. The spring tightening is adjusted by screw 40 in cover 39.

Placed between valve seat 31 and ball bearings 61 is diaphragm body (eccentric) 51, whose flange has twelve holes spaced evenly along its circumference.

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Three studs with nuts secure the flange with cover 55 to the governor body.

In case it is necessary to change the length of lever 50 and which is transmitting pressure, the diaphragm body 51 is turned and secured in a new position.

Rubber diaphragm 52, supporting ring 54 and block 53, is pressed between cover 55 and the diaphragm body flange. The block supports rod 56, whose other end rests against the head of adjusting micrometric screw 41, turned into the lever.

With valve 29 closed, block 53 should be flush with, or project above, the ring by 0.03 mm (to be adjusted by micrometric screw 41).

The parts of the diaphragm body are coated with special graphite oil. To preserve the lubricant during operation, rubber gland 57, covered with cap 58, is put on the rod.

The afterburner governor comprises the following parts: the membrane, the governor lever, the valve with valve seat, the adjusting screw and springs. Membrane 16 is manufactured of rubber cloth, 0.35 mm thick. At the joints, between the body and cover flange and the membrane the latter is fitted with a rubber cloth ring to provide for strength and tightness. The membrane is secured between two aluminium discs 15 and 18 by two rows of rivets, six in each row. The middle portion of disc 18 has a projection for limiting the travel of the membrane towards cover 19.

After assembly the membrane unit is mounted on the flange of the aneroid housing, closed with cover 19 and secured by eight bolts.

The construction of governor lever (28) unit is similar to the barostat lever unit except for the end stop. The lever is mounted on pin 60 in the governor body. To ensure the airtightness of the joint between the fuel and air cavities, washer 23 of proper thickness is provided to compress cup 24 by 0.2 - 0.4 mm. The fuel valve and the barostat valve are similar in construction.

With the lever unloaded the clearance between valve seat 31 and valve 29 should be adjusted within 0.03 - 0.5 mm by selecting shims 34. After this stop 25 should be brought to the valve to limit the lever movement within the clearance; then the stop should be locked with nut 27 and

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covered with cap 26 fitted with a rubber packing ring.

Lever stop 6 supports rod 8, whose centring collar mounts spring 10. The cylindrical part of the rod enters sleeve 9. The longitudinal sleeve hole is aligned with the hole in the rod and houses pin 17. Bushing 11, whose collar mounts expansion spring 10, holds pin 17 in place.

Parts 8, 9, 10, 11, 17 constitute an elastic medium between the membrane and the lever. From the opposite side stop 6 is acted upon by spring 4 through disc 5. Adjusting screw 3 (with a ball type lock), secured in the threaded hole of cover 2, is employed to tighten spring 4. Four studs attach cover 2, of steel, to the aneroid housing. From outside plug 1 is turned into the cover threaded hole.

Pipe union 7, screwed into the aneroid housing, feeds air at p_2 pressure from the engine compressor.

Membrane cover 19 houses threaded bushing 14 with a protective screen. Pipe union 12 clamps nipple 13 which transmits gas pressure p_4 .

The construction of the interlocking switch is similar to that of unit HP-11A, the only difference being that lever 14 (Fig. 45) has adjusting screw 15 which makes it possible to time the electric contactor operation more exactly.

XIX. HP-10AKC AND HP-11BA UNITS. GENERAL REQUIREMENTS FOR MOUNTING AND OPERATION

General requirements for mounting and operation of units HP-10AKC and HP-11BA are essentially the same as those for units HP-10A and HP-11A.

Given below are additional instructions on adjustment of the HP-11BA unit in service.

In case gas temperature T_4 deviates from the specified limits by more than 30°C , employ adjusting screw 3 of the afterburner governor (See Fig. 44) to restore the temperature to the required level. Turning the screw out reduces the gas temperature and vice versa.

It is not recommended to adjust fuel consumption by the altitude characteristics of the barostatic flow control unit

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as these characteristics are rated for somewhat excessive fuel consumption under augmented conditions.

XX. TESTING AND ADJUSTING UNITS ON SPECIAL TEST STANDS

Units HP-10AKC and HP-11BA are tested and adjusted on the same test stands as the HP-10A and HP-11A units (diagrammed in Figs 30 and 31).

1. HP-10AKC Unit

Unit HP-10AKC is adjusted in the same manner as the HP-10A unit, except for the following:

1. At $Q = 2200 \pm 125$ lit/hr at the beginning of automatic operation the unit should run at 3070₋₆₀ r.p.m.

The angle of turn of the throttle valve from the CUT-OFF (ОСТАВ) stop to the beginning of automatic operation (\angle) should be $50 \pm 5^\circ$.

2. At $n = 3500$ r.p.m., when the throttle valve lever is shifted abruptly from the IDLING RATING to the FULL THROTTLE sector, the time period of operation of the hydraulic decelerator servopiston should take from 10 to 13 sec.

3. At $n = 3100$ r.p.m., with the minimum pressure valve inoperative, the stop of minimum fuel delivery is set at $Q = 200^{+20}$ lit/hr; the minimum pressure valve is adjusted by fitting washers 107 (Fig. 20) and changing the valve spring tension to ensure fuel consumption of $Q = 300 \pm 20$ lit/hr at $n = 3500$ r.p.m. and the throttle valve lever set at the IDLING RATING sector. The total thickness of the washers should not exceed 6 mm. During adjustment no air (p_2) is fed into the acceleration control unit if the latter has been already adjusted. The fuel consumption is measured after shifting the throttle valve lever from the FULL THROTTLE to the IDLING RATING sector.

While adjusting the minimum pressure valve fuel pressure p_2 at the pump inlet should be maintained within 2 ± 0.1 kg/cm² and fuel pressure after the equivalent jets should be maintained within 2 ± 0.2 kg/cm².

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To check the stability of minimum pressure valve operation the pressure should be reduced two or three times in the following manner: the throttle valve lever will be shifted from the middle of the IDLING RATING (МАЛЫЙ ГАЗ) sector to the FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop at any speed, and with the fuel pressure reaching the value limited by the acceleration control valve (no air is fed) the lever will be shifted (within 1-2 sec.) to the middle of the IDLING RATING sector.

With the lever in the extreme positions, at a speed of 3500 r.p.m., the difference in fuel consumption must be within the limits of 280 through 320 lit/hr.

It is allowed to select a jet feeding fuel into the fuel cavity of the wobble plate servopiston with the dia. of the orifice within 0.7 to 1 mm.

4. Checking operation of the fuel return valve.

To check the valve operation energize the electromagnet by applying 22 - 28 V D.C. for 20 sec. An oscillograph transmitter is connected to the fuel line of the primary manifold. The throttle valve lever is placed on the FULL THROTTLE (ПОЛНЫЙ ГАЗ) stop.

With the electric magnet energized, take an oscillogram of the unit operation. The return valve must decrease the fuel delivery by at least 50% when the unit is operating at speeds, exceeding those at which fuel flow is controlled automatically. At lower speeds a 40% decrease in the valve flow rate must follow within 0.15 sec. since the moment of pressure drop. The oscillographic test is carried out at 3500, 3200 and 2500 r.p.m.

The electric magnet will be deenergized within 0.2 - 0.25 sec.

The rate of fuel flow decrease should be determined by the oscillogram which records variations in fuel pressure in the primary manifold from the beginning of pressure drop during 0.15 sec. The pressure should be referred to the total fuel consumption as recorded by fuel pressure in the primary manifold in accordance with the characteristics of the unit distribution valve.

After the electromagnet has been cut out the initial speed should be restored within not more than 35 sec.

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Fig. 46 reflects the main characteristics of the HP-10A and HP-10AKC units.

2. HP-11BA Unit

Testing and adjustment of units (except when specified otherwise) is carried out under the following conditions:

1. The unit pump speed - 3565 ± 30 r.p.m.
2. Fuel pressure at pump inlet $P_f = 2.5 \pm 0.2$ kg/cm²;
3. To energize the electromagnet, 20 - 26 V D.C. is supplied.
4. A calibrated jet ensuring fuel consumption of 3700 ± 40 lit/hr is fitted at the unit outlet.
5. Adjustment is carried out with the afterburner governor valve closed under air pressure (P_2) in the membrane cavity or by air rarefaction (P_4) from the opposite side of the membrane. The pressure drop across the membrane must be within 0.1 - 1.0 kg/cm².
6. Fuel pressure is changed in the unit by feeding air pressure or by creation of a rarefaction in the aneroid chamber.

The units characteristics obtained on test stands must comply with the following data:

1. With the electric magnet energized fuel pressure P_f before the afterburner valve must be 18 ± 4 kg/cm². Adjustment is carried out through the agency of the minimum delivery thrust screw.
2. With the electric magnet (solenoid) de-energized and P_1 pressure being equal to B_0 in the aneroid chamber (ambient pressure), the constant pressure valve must ensure 10^{+2} kg/cm² fuel pressure at the valve outlet.

Adjustment is carried out by employing washers (not more than 3 pieces) to change the valve spring tension.

3. The fuel valve must open at $P_f = 18 \pm 4$ kg/cm² and fuel flow rate Q from 150 to 1000 cu.cm/min. Adjustment is achieved by means of the screw of the fuel valve spring.

4. The altitude performance data of the barostatic flow control unit must be as follows:

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Pressure p_1 in aneroid chamber, mm of Hg	70	100	200	300	500	760-1000
Fuel consumption (from - to), lit/hr.....	500	720	1400	2000	2900	3620
	600	820	1600	2250	3350	3740

With the electric magnet energized the altitude performance of the barostatic control unit is adjusted by the fuel valve spring (within 18 ± 4 kg/cm² allowance), the aneroid spring, the adjusting screw of the barostat valve spring, by turning the eccentric, and by selecting a 3.8 - 4.2 mm block.

Maximum fuel consumption is to be limited by the wobble plate maximum tilt stop.

To obtain altitude performance data, gradually decrease pressure p_1 in the aneroid chamber beginning with $p_1 = 500$ mm of Hg up to altitude pressure and increasing it from $p_1 = 500$ mm of Hg up to boost pressure.

5. The afterburner governor is adjusted with the barostat valve closed and boost pressure $p_1 = 1000 - 2000$ mm of Hg in the aneroid chamber. The adjustment procedure is as follows:

A. With the pressure difference across the membrane of the afterburner governor of 150 mm of water, adjust the fuel consumption Q at 750 - 1250 lit/hr by changing the tension of spring 4 (Fig.44).

B. Take the characteristics of changes in fuel consumption depending on pressure difference ($p_2 - p_4$) in the following order:

(a) create pressure difference ($p_2 - p_4$) across the afterburner governor membrane to ensure 300 - 350 lit/hr fuel consumption and record the pressure difference;

(b) increase the pressure difference value across the afterburner governor membrane through every 50 mm of water (beginning from the initial recorded value) and record the pressure difference value at which the unit develops maximum fuel delivery;

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(c) see that the pressure difference as registered under "a" and "b" does not exceed 350 mm of water;

(d) see that the hysteresis does not exceed 50 mm of water when the characteristics are checked in the reverse order (by decreasing the pressure difference values).

Notes: 1. It is allowed to employ kerosene when checking the pressure difference, provided the water column pressure is referred to kerosene specific gravity.

2. When checking fuel consumption the pressure difference ($p_2 - p_4$) will be created beginning with maximum fuel consumption.

(e) pressure at the afterburner valve inlet at minimum fuel consumption is to be at least 12 kg/cm². The adjustment is carried out by the minimum output screw;

6. At $p_1 = 220$ mm of Hg pressure in the aneroid chamber, the time period required to open or close the afterburner valve should be as follows:

(a) when the afterburner is turned on the pressure increase before the calibrated jet from 10 to 90% of total pressure should take place within 1 - 3 sec.;

(b) the electric contactor must be cut in 5 - 8 sec. after 90% of total pressure value has been obtained;

(c) the afterburner valve must fully close (fuel pressure should decrease) during no more than 1.5 sec.;

Notes: 1. Allowed "idle run" period from the moment of energizing the electric magnet to the moment fuel pressure starts increasing (up to 10% of total fuel pressure at the calibrated jet inlet) is not to exceed 2.5 sec.;

2. The speed of the afterburner valve opening and closing is adjusted by the servopiston damper or by selecting a 2AHK throttling assembly with a 80 - 140 cu.cm/min. flow rate.

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7. With the electric magnet deenergized fuel return from the rotor cavity (into the fuel feed pipe line) must be not over 300 - 600 lit/hr.

8. At maximum r.p.m., $P_1 = B_0$, fuel pressure $P_f = 3.4 \text{ kg/cm}^2$ at the unit inlet, and the electric magnet deenergized, fuel leakage through the pipe union directing fuel to the burners is not to exceed 15 cu.cm/min.

9. At $n = 0$, the electric magnet deenergized, and 0.5 kg/cm^2 fuel pressure P_f at the unit inlet, fuel leakage via the pipe union directing fuel to the burners is not to exceed 1 cu.cm/min (after three minute check).

10. Fuel leakage into the atmosphere through the vent system of the running unit is not to exceed 60 cu.cm/min.

11. The unit must remain airtight when tested during 5 min. at maximum rating, with the electric magnet energized and fuel pressure P_f at the pump inlet being 3.4 kg/cm^2 .

XXI. SINGLE SET OF SPARE PARTS FOR UNITS

No.	Part No.	Name	Quantity
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1. HP-10 AKC Unit

1	276-338	Packing ring	2
2	90-191	Gasket	1
3	90-200	Packing ring	2
4	370-148	Bolt	1
5	2609C6-1,5T	Packing ring	3
6	2609C8-2-T	Same	4
7	2609C10-2-T	Same	4
8	2609C11-1,5T	Same	2
9	2609C12-1,5-T	Same	2
10	2609C12-2-T	Same	4
11	2609C14-2-T	Same	2
12	2609C15-1,5-T	Same	2
13	2609C16-2-T	Same	4
14	2609C18-2-T	Same	2
15	2609C20-2,5-T	Same	2

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No.	Part No.	Name	Quantity
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2. HP-11BA Unit

1	90-200	Packing ring	1
2	90-191	Gasket	1
3	276-247	Sealing ring	2
4	276-338	Same	1
5	2609C52-6-1.5-T	Same	2
6	2609C52-7-1.5-T	Same	2
7	2609C52-8-2-T	Same	3
8	2609C52-12-2-T	Same	1
9	2609C52-14-2-T	Same	2
10	2609C52-16-2-T	Same	2
11	2609C52-18-2-T	Same	1
12	2609C52-25-2-T	Same	1

XXII. MAIN MODIFIED PARTS AND PARTS SUPPLIED
ADDITIONALLY FOR HP-10A and HP-10AKC UNITS

Ref. No. as given in Figs 42,43	Series No.	Description	Quantity	Material	Note
1	2	3	4	5	6
1	351011E	Governor body with slide valve and throttle valve needle	1	-	For HP-10A and HP-10AKC units Same
-	351012B	Fuel distributor body with slide valves and rod of hydraulic decelerator	1	-	

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1	2	3	4	5	6
-	351013	Pump body with bushing of wobble plate piston rod	1	-	For HP-10A and HP-10AKC units
-	351052	Rotor with bushings	1	-	Same
-	351053	Rotor with plungers and shaft	1	-	Same
11	351054	Damper (jet with gauze)	1	-	Same
-	400024	Adjusting head of idling rating valve	1	-	Same
-	400025	Adjusting head of acceleration control unit and starting control unit	2	-	Same
10	351054	Electric magnet of relief valve	1	-	For HP-10AKC unit
1	351101E	Governor body	1	Aluminum alloy AM9	For HP-10A and HP-10AKC units
1	351102B	Fuel distributor body	1	Aluminum alloy AM9	Same
-	351103	Pump body	1	Same	Same
2	351204	Adapter for relief valve electromagnet	1	Steel X17H2	For HP-10AKC unit
13	351205	Bushing for relief valve slide	1	Steel X18	For HP-10A and HP-10AKC units
12	351206-1	Slide valve	1	Steel LX13	For HP-10A unit
12	351206A	Slide valve for relief valve	1	Same	For HP-10AKC unit

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1	2	3	4	5	6
14	351207	Spring guide for relief valve	1 set	Steel 3X13	For HP-10A and HP-10AKC units
-	351208A	Spring	1	Wire, steel, dia. 1.4 50X0A	Same
-	351224	Bearing body of wobble plate	1	Steel 16 X17H	Same
-	351225	Cover for relief valve slide	1	Steel 45	For HP-10A unit
-	351226	Damper gauze	1	Gauze No. 004B	For HP-10A and HP-10AKC units
-	351228	Damper jet	1	Brass MC59-1	Same
-	351235	Adjusting screw of distributing valve	1	Steel 2X13	Same
-	380252	Handle of adjusting head	3	Steel 2X13	Same
-	380253	Adjusting head spring	3	Steel wire, dia. 1 (OEC)	Same
-	380254	Pin	3	Wire, steel, dia. 1.7 (OEC)	Same
-	380257	Cover of acceleration control unit and starting control unit	2	Aluminum alloy AM9	

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1	2	3	4	5	6
-	400115	Adjusting head pipe union	3	Steel 2X13	For HP-10A and HP-10AKC units
-	400117	Idling rating valve shaft	1	Steel 12XH3A	Same
-	400118	Idling rating valve screw	1	Steel 2X13	Same
-	400119	Idling rating valve	1	Steel 2X13	Same
-	400120A	Shaft of adjusting head of acceleration control unit and starting control unit	2	Steel 12XH3A	Same
-	400121E	Spring support of adjusting head	2	Steel 38XA	Same
-	400149	Packing ring of hydraulic decelerator rod	1	Rubber set 4327	Same
-	400157	Washer of adjusting head	3	Steel set 1118H90H	Same
-	400158	Constant pressure drop valve	1	Steel 4X14H14B2M	Same
-	400159	Bushing of constant pressure drop valve	1	Same	Same
-	409 101-2	Rotor	1	Steel 12XH3A	Same
-	409104-2	Rotor bushing	7	Brass BE-24	Same
-	417105	Socket for fuel valve of starting control unit	1	Steel 3X13	Same

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1	2	3	4	5	6
-	H3-03-2	Retaining lock	1	Steel 20	
-	H3-05-1	Same	4	Same	
-	H3-05-2	Same	14	Same	
-	H3-09-1	Same	2	Same	
-	H3-10	Same	1	Same	
-	H3-13	Same	4	Same	

Parts 351-206-1, 351-207A and 351225 installed in unit HP-10A do not take part in unit operation, but act as blanking plugs in the modified body of the HP-10A unit and the body of the HP-10AKC unit.

XXIII. MODIFIED PARTS AND PARTS SUPPLIED
ADDITIONALLY FOR HP-11BA UNIT

Ref. No.	Fig.	Series No.	Description	Quantity	Material
1	2	3	4	5	6
15	45	244093-1	Switch adjusting screw	1	
26	45	336009C	Electromagnet	1	
-		336016	Panel	1	
-		336017	Electromagnet body with cylinder	1	
37	45	351006B-2	Cover of rotor cavity (assembled)	1	
-		351058	Body with bearing	1	
-		361096	Fine filter (assembled)	1	
1	45	373011K	Pump body	1	
59	44	373012A	Governor body	1	
49	44	373013	Aneroid housing	1	
-		373015	Contactactor body	1	
-		373016	Contactactor body with switch	1	
28	44	373018B	Governor lever	1	
-		373019	Cover	1	
14	45	373020	Lever	1	

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1	2	3	4	5	6
21	45	373025	Cut-off valve seat	1	
-		379026	Valve body	1	
		373027	Cut-off valve	1	
		373043	Governor valve	2	
-		373044A	Barostat lever	1	
7	44	373045	Pipe union (with screen) feeding pressure P ₂	1	
3	44	373047	Adjusting screw of afterburner governor valve	1	
25	45	380081	Air bleed valve	1	
16	44	381045A	Membrane	1	
-		409011	Rotor with plungers	1	
		409012	Rotor with bushings	1	
		409015	Wobble plate piston rod	1	
13	45	EX-1-140	Switch	1	
-		ET-3	Plug	1	
31	45	24HX60-140	Throttling assembly	1	
61	44	No.24	Ball bearing	4	
-		90119	Lock ring	1	Steel 65T
8	45	90127-3	Pin of bearing body	2	Steel 21XH3A
-		90128	Pin packing ring	4	Rubber 4327
-		90129	Shims for wobble plate	2	Steel 2X18H9OH
4	45	147117	Rotor bearing	1	Copper-graphite compound MCHCM
34	44	148110	Packing ring of valve seat	1	Copper M2
15	45	225156	Spring washer	1	Steel 50X0A
		244147	Adjusting screw	1	Steel 2X13
		276115	Slide valve lock	1	Bronze EpB-2, beryllium

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1	2	3	4	5	6
		276124	Screw fastening rotor cavity cover	2	Steel 38XA
		276124-1	Screw fastening rotor cavity cover	2	Steel 38XA
		276205	Plug for drain duct of rotor cavity cover	1	Aluminium alloy AIT
-		276289	Plug of throttling assembly	1	Steel 45
		296217	Adjusting washer of afterburner valve piston	1 set	Steel 20
		296229	Ring centring gland cover	1	Aluminium alloy AIT
35	45	311211	Gland body	1	Same
-		317011-2	Winding	3180 turns	Wire MSB-2
		317011-3	Wire, dia. 0.2 mm	0.6	Wire MTW40
		317011-4	Insulation tape	1	Doped fabric Aut-2
		317011-5	370x24x0.15 Pipe, inner dia. 2 mm	1	Vinyl chloride
		336115	Electromagnet panel	1	Steel 10
		336116	Body	1	Same
		336117	Cylinder	1	Brass MC59-1
		336118	Nut	1	Steel 45
		351115	Ring for packing switch rod	set	Rubber 4327
22	45	351119-0.6	By-pass valve jet	1	Steel 1X13
37	45	351173	Cover of rotor cavity	1	Aluminium alloy A19
38	45	351224	Bearing body of wobble plate	1	Steel 16X1T1
16	45	351235	Fuel valve adjusting screw	1	Steel 2X13
34	45	361601	Rotor shaft	1	18XHBA
		361621	Rotor splined bushing	1	12XH3A
		361622	Rotor plug	1	Steel 45
		361625	Filter body	1	

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1	2	3	4	5	6
		361626	Spring	1	Wire, steel, dia. 0.5 (50XΦA)
		361627	Disc	16-18	Brass M62
		361628	Ring	16-18	Same
		361629	Filter screen	32-36	Screen No.004B
		361630	Frame screen	32-36	Screen No.04B
-		361631	Ring	32-36	Brass M62
-		361632	Same	32-36	Same
		361633	Washer	1	Steel 2X18H9M
		361634	Bushing	1	Steel 16X1TA
		363162	Adjusting gasket of cut-off valve	1 set	Steel 2X13
24	44	368514	Cup	2	Rubber 4327
		368523	Plug for lever cavity	1	Steel 45
62	44	368524	Spacer ring	2	Steel Y8A
21	44	368530	Washer cup	2	Aluminium alloy A1AT
		368532A	Adjusting washer	1 set	Steel 1X18H9
		370165A	Plug of servopiston rod	1	Steel 45
	45	373101K	Pump body	1	Aluminium alloy A19
59	44	373102A	Governor body	1	Same
49	44	373103A	Aneroid housing	1	Same
-		373104	Contact body	1	Aluminium alloy A19
-		373107	Servopiston bushing	1	Steel 80XICA
28	44	373109B	Governor lever	1	Steel 16X1TA
50	44	373110B	Barostat lever	1	Same

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1	2	3	4	5	6
20	44	373113	Nut of barostat and governor lever	2	Steel 1X13
-		373116	Gasket of wobble plate pin cover	2	Flexible textolite
		373117	Cover of wobble plate pin	2	Steel 20
		373118A	Stud of aneroid hous- ing	2	Steel 38XA
		373119	Same	3	Steel 38XA
55	44	373121	Cover of barostat eccentric	1	Steel 1X13
-		373122	Packing ring of barostat bushing	2	Rubber 4327
-		373123	Barostat space bushing	1	Steel 1X13
-		373124	Switch cover	1	Aluminium alloy A19
14	45	373125A	Switch lever	1	Steel 16X1TA
-		373126	Nut of afterburner valve	1	Steel 1X13
12	45	373127	Switch rod	1	Steel 1X13
		373128	Pin of switch lever	1	Steel 2X13
-		373129	Lever stop	1	Same
		373130	Guide of switch slide	1	Steel 1X13
-		373131	Switch slide	1	Bronze SpaM10-3-1,5
-		373132	Slide spring	1	Wire, dia.1.6 (OBC)
-		373133	Screw fastening switch	2	Steel 45
-		373134	Plug of switch cover	1	Steel 45
-		373135	Insulation plate	1	Textolite HT
-		373136	Bushing of switch rod	1	Steel 1X18
13	44	373144	Swivel nipple supply- ing pressure P _A	1	Steel 45
-		373146	Cut-off valve body	1	Steel 38XA
		373147	Cap of cut-off valve body	1	Steel 45

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1	2	3	4	5	6
		373148A	Swivel elbow of cut-off valve	1	Steel 16X17A
21	45	373149A	Cut-off valve seat	1	Steel 45
20	45	373150	Cut-off valve	1	Steel 2X13
-		373151	Spring support of cut-off valve	1	Steel 2X13
-		373152	Cut-off valve spring	1	Wire, dia. 1.6 (50XΦA)
24	45	373153	Afterburner valve	1	Bronze EpAXH10-4-4
23	45	373154	Afterburner valve bushing	1	Steel X18
2	44	373160A	Cover of afterburner governor adjusting screw	1	Steel 2X13
6	44	373161	Lever stop of afterburner governor	1	Steel 2X13
8	44	373162	Rod stop	1	Steel 3X13
10	44	373163B	Rod spring	1	Wire, dia. 1.5 (OBC)
9	44	373154	Rod sleeve	1	Steel 3X13
4	44	373166	Spring of afterburner governor adjusting screw	1	Wire, dia. 1.4 (OBC)
-		373168	Gasket of rotor cavity cover	1	Paronite YB-10
35	44	373194	Barostat valve spring stop	1	Steel 3X13
29	44	373195	Governor and barostat valve disc	2	Steel 18XHBA
7	44	373196	Pipe union feeding pressure p ₂	1	Steel 45
22	44	373197	Barostat valve cavity cover	1	Aluminium alloy A19
		373198	Governor lever stop	1	Steel 2X13

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1	2	3	4	5	6
37	44	373199	Barostat valve spring	1	Wire, dia. 2.33 (50XΦA)
3	44	373201	Afterburner governor valve adjusting screw	1	Steel 38XA
-		381133	Wobble plate piston rod bushing	1	Bronze EpAXH10-4-4
-		381134	Piston rod	1	Steel 12XH3A
19	44	381204A	Afterburner governor membrane cavity cover	1	Aluminium alloy A19
5	44	381226	Governor screw spring retainer	2	Steel X18
		381227	Gasket for barostat valve cavity cover	1	Paronite YB-10
38	44	381255	Barostat lever stop	1	Steel 2X13
18	44	381258	Membrane disc	1	Aluminium alloy A1T
60	44	381263A	Lever bearing pin	2	Steel 16X17A
23	44	381267	Cup washer	2	Aluminium alloy A1T
22	44	381270	Cup holder	2	Same
-		381272	Spring	1	Wire, dia. 1.6 (OBC)
15	44	381274	Membrane disc	1	Aluminium alloy A1AT
16	44	381275	Membrane	1	Membrane cloth EMP
-		383128	Membrane support	1	Steel X18
11	44	383135	Spring bushing	1	Aluminium alloy A1T
2	45	409101-1	Rotor	1	Steel 12XH3A
7	45	409102	Plunger	7	Steel XEF
6	45	409103	Plunger spring guide	7	Steel SCMA

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1	2	3	4	5	6
		409104-1	Rotor bushing	7	Bronze BE24
		409105	Plunger spring	7	Wire, dia. 1.6 (50X9A)
3	45	409106	Rotor slide valve	1	Bronze BE23
39	45	409111	Maximum output stop screw	1	Steel 12XH3A
-		409112	Governor body stud	1	Steel 38XA
-		409114	Gasket for switch cover	1	Paronite YB-10
-		409115	Afterburner governor valve stop	1	Steel 3X13
		2213	Spring for adjusting screw balls	2	Wire, dia. 0.5 (OEC)
-		15A49-5	Spring washer	2	Steel 65T
-		12HK12x1.5	Plug	1	Steel 45
-		12HK16x1.5	Same	1	Same
-		20HK5	Stopper	1	Aluminium alloy A1T
-		25HK0.9	Jet	38	Steel 1X18H9M
-		30HK4	Blind pipe union	1	Steel 45
-		34HK5	Blind nut	1	Steel 45
-		35HK5	Nut	1	Same
-		37HK11-6-45	Adjusting screw	1	Steel 38XA
-		48HK5	Spring washer	12	Steel 50X9A
-		48HK6	Same	10	Steel 50X9A
-		49HK6-1.0	Jet	1	Steel 1X13
-		62HK14x1.5	Protection cap	1	Phenolic material
-		62HK16x1.5	Same	3	E-18-2
-		62HK18-1.5	Same	1	Same
-		62HK20-1.5	Protection cap	2	Same
-		62HK24-1.5	Same	1	Same
-		62HK28-1.5	Adjusting washer	1	Steel 1X13

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1	2	3	4	5	6
-		64HK8.5-12- -0.7	Adjusting washer	1	Steel 1X13
-		64HK0.8-12- -1.5	Same	1	Same
-		64HK10x1.5	Plug	1	Steel 45
-		213M53-4-10	Dowel	2	Steel 38XA
-		216M51-5	Nut	1	Same
-		216M51-6	Same	2	Same
-		216M51-5	Same	13	Same
-		216M51-6	Same	12	Same
-		229M51-6-42	Same	1	Same
-		229M51-6-60	Same	4	Same
-		229M51-6-72	Same	5	Same
-		234A50-0.5- -4-7	Washer	1	Steel 20
-		234A50-0.8- -4-8	Same	1	Same
-		234A50-1-6- -12	Washer	28	Steel 20
-		234A50-1-8- -12	Same	1	Same
-		237M51-6-18	Bolt	6	Steel 38XA
-		238M51-6-28	Bolt	2	Same
-		564M50-24	Spring ring, flat	1	Steel 65T
-		1301C51-6- -60	Bolt	2	Steel 45
-		1406C51-4	Castle nut	1	Same
-		2008A50-2.6- -6	Rivet	12	Aluminium alloy A16H
-		2609C52-4.5- -1.5-T	Packing ring	2	Rubber 4327
-		2609C52-6- -1.5-T	Same	8	Same
-		2609C52-10- -2-T	Same	1	Rubber E-14
-		2609C52-10- -2-T	Same	1	Rubber 4327
-		2609C52-14- -1.5-T	Same	1	Same

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1	2	3	4	5	6
-		2609C52-22-2.5-I	Packing ring	1	Rubber 4327
-		2609C52-25-2-I	Same	1	Rubber 4327
		2609C52-28-3-I	Same	1	Same
		2609C52-30-2-I	Same	2	Same
		2622C53-6x1	Plug	2	Steel 45
		H-2006	Bolt	6	Same
		H-9910	Seal	18	Aluminium alloy
		H3-03-1	Lock	4	Steel 20
		H3-03-2	Same	1	Same
		H3-04-2	Same	9	Same
		H3-05-1	Same	2	Same
		H3-05-2	Same	9	Same
		H3-07	Same	3	Same
		H3-09-2	Same	1	Same
		H3-12	Same	2	Same
		H3-16	Same	2	Same
		1x12	Cotter pin	1	
		1.5x20	Cotter pin	2	
		2x8	Roller, needle	1	Steel MX6
		6II 1/8" II	Ball	4	Steel MX6
		II 3/16" H	Ball	1	Steel MX6

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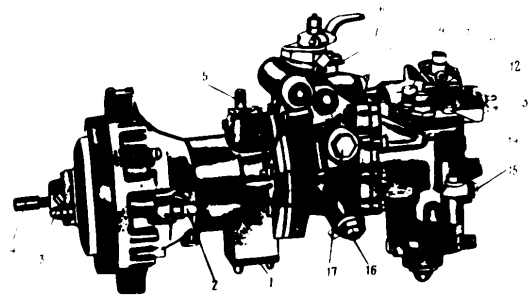


Fig. 1. HP-10 A Unit, Control Lever View

1 - cover of fuel delivery cavity; 2 - cap of wobble plate maximum delivery stop screw; 3 - pipe union to measure fuel pressure at throttle valve inlet; 4 - pump rotor shaft; 5 - pipe union to measure fuel pressure at throttle valve inlet; 6 - control lever; 7 - adjusting screw of throttle valve stop in engine CUT-OFF (OCTA) position; 8 - cap of low speed valve adjusting screw; 9 - pipe union for branching fuel to burners primary manifold; 10 - fuel vent pipe union; 11 - pipe union for supplying fuel to burners main manifold; 12 - cap of maximum r.p.m. adjusting screw; 13 - switch adjusting screw cap; 14 - throttling assembly of minimum pressure valve; 15 - fuel vent pipe union; 16 - constant pressure valve plug; 17 - constant pressure drop valve plug.

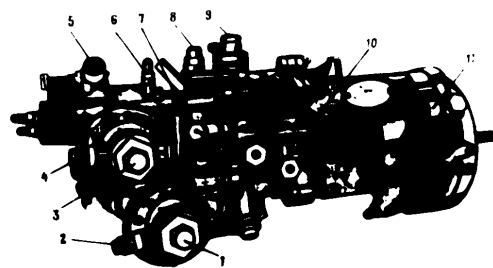


Fig. 2. HP-10 A Unit, View of Acceleration Control Unit and Sealing Control Unit Adjusting Elements

1 - cap of acceleration control unit adjusting screw; 2 - pipe union delivering air under pressure (P_g) connected by pressure relief (P_g) 3 - cap of acceleration control unit adjusting screw; 4 - plug connecting 5 - cap of throttling valve adjusting screw; 6 - cap of hydraulic deceleration; 7 - cap of shut-off valve; 8 - pipe union for measuring pressure at throttle valve inlet; 9 - throttling assembly, adjusting wobble plate rate of turn; 10 - fuel vent pipe union.

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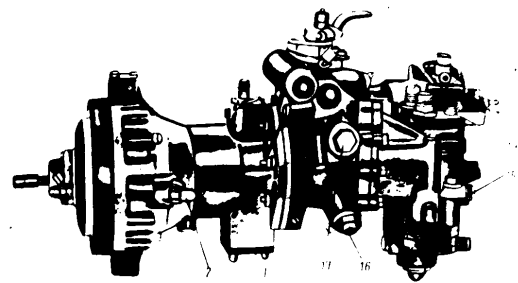


Fig. 1. HP-10 A Unit, Control Lever View

1 - cover of fuel delivery cavity; 2 - cap of wobble plate maximum delivery stop screw; 3 - cap of wobble plate minimum delivery stop screw; 4 - pump rotor shaft; 5 - pipe union to measure fuel pressure at throttle valve inlet; 6 - control lever; 7 - adjusting screw of throttle valve stop in engine CUT-OFF (OCTAHOE) position; 8 - cap of low speed valve adjusting screw; 9 - pipe union for branching fuel to burners primary manifold; 10 - fuel vent pipe union; 11 - pipe union for supplying fuel to burners main manifold; 12 - cap of maximum r.p.m. adjusting screw; 13 - switch adjusting screw cap; 14 - throttling assembly of minimum pressure valve; 15 - fuel vent pipe union; 16 - constant pressure valve plug; 17 - constant pressure drop valve plug.

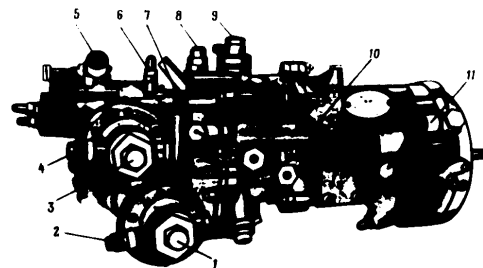


Fig. 2. HP-10 A Unit, View of Acceleration Control Unit and Starting Control Unit Adjusting Elements

1 - cap of acceleration control unit adjusting screw; 2, 4 - pipe unions delivering air under pressure (p₂) connected by pressure relief jet; 3 - cap of acceleration control unit adjusting screw; 5 - plug connecting; 6 - cap of discharging valve adjusting screw; 7 - throttling assembly of hydraulic deceleration; 8 - air bleed valve; 9 - pipe union for measuring pressure at throttle valve outlet; 10 - throttling assembly, adjusting wobble plate rate of turn; 11 - fuel vent pipe union.

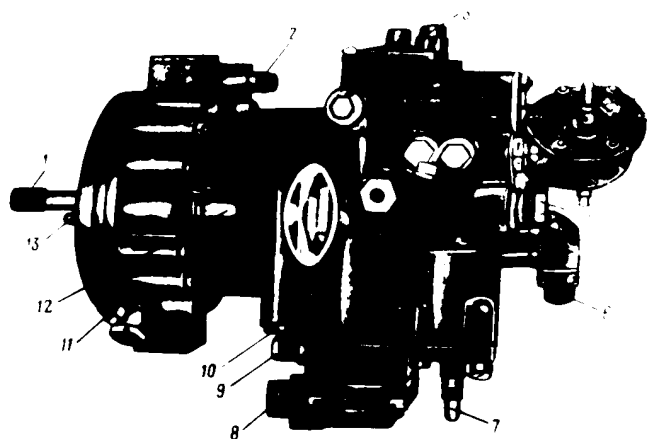


Fig. 3. HP-11 Unit. View of Afterburner Valve Switch

1 - shaft; 2 - pipe union by-passing fuel to HP-10 A unit inlet; 3 - air bleed valve; 4 - pipe union delivering air into aneroid chamber; 5 - pipe union delivering fuel to afterburner nozzles; 6 - electromagnet plug connector; 7 - cap of fuel valve adjusting screw; 8 - plug connector of afterburner valve switch; 9, 11 - fuel vent pipe unions; 10 - high pressure filter; 12 - maximum output adjusting screw cap; 13 - minimum output adjusting screw cap.

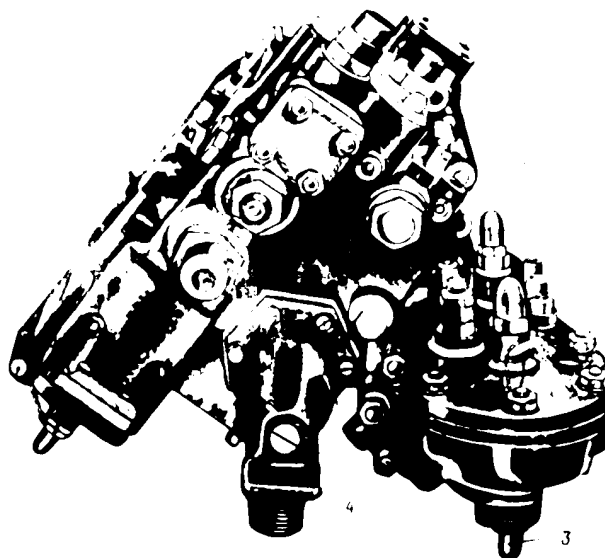


Fig. 4. HP-11 A Unit. View of Electromagnet and Barostat

1 - cap of adjusting screw of barostat spring; 2 - cap of adjusting screw of barostat aneroid; 3 - cap of stop screw of barostat lever; 4 - electromagnet plug connector. Note: The barostat assembly is a separate unit which is connected to the main fuel line by a pipe union. The barostat pressure valve plug is located in the main fuel line.

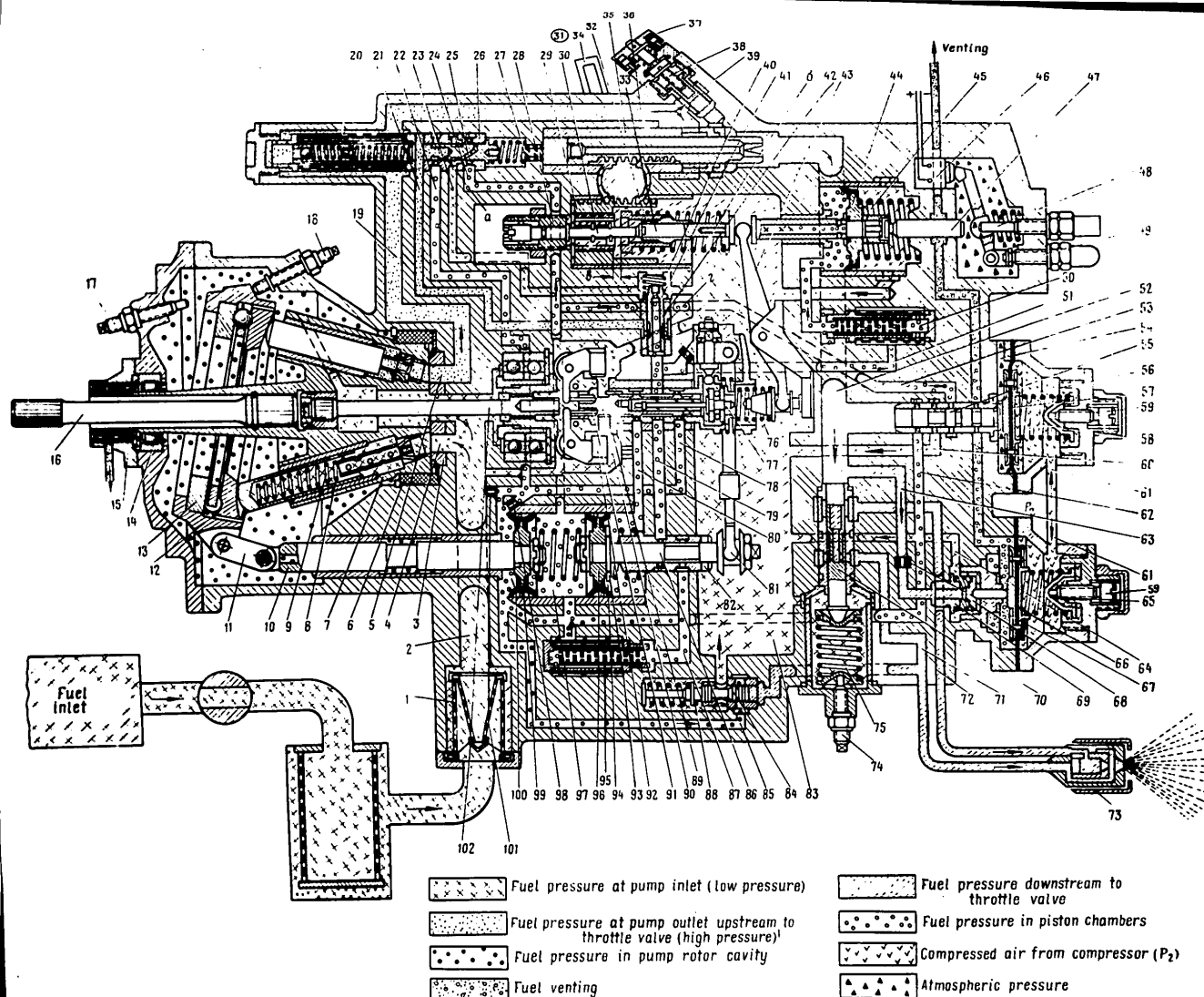


Fig. 5. HP-10A Unit Key Diagram

1 - unit inlet filter; 2 - fuel feed duct; 3 - ported member; 4 - port in low pressure line; 5 - port in high pressure line; 6 - copper-graphite bearing; 7 - rotor; 8 - plunger; 9 - plunger opening; 10 - piston rod; 11 - link connecting piston with wobble plate; 12 - wobble plate (housing body); 13 - wobble plate bearing; 14 - roller bearing; 15 - gland; 16 - shaft; 17 - wobble plate minimum delivery stop screw; 18 - wobble plate maximum delivery; 19 - pump outlet duct stop screw; 20 - governor filter; 21 - duct feeding fuel into contact pressure valve; 22 - duct feeding fuel into wobble plate piston chamber; 23 - fuel return duct; 24 - duct for routing fuel from inter-piston chamber; 25 - constant pressure drop valve; 26 - valve sleeve; 27 - damper; 28 - screw for adjusting the beginning of automatic operation; 29 - rack; 30 - stop screw of decelerator rod; 31 - spring; 32 - coupling; 33 - decelerator rod; 34 - control lever; 35 - throttle valve; 36 - valve needle bushing; 37 - tilting rotating screw adjusting head; 38 - tilting rotating screw; 39 - slide valve; 40 - constant pressure valve spring; 41 - constant pressure valve; 42 - valve bushing; 43 - slide valve lever; 44 - decelerator piston; 45 - piston spring; 46 - switch; 47 - rod; 48 - minimum s.p.m. adjusting screw; 49 - switch adjusting screw; 50 - decelerator damping assembly; 51 - duct connecting decelerator throttling assembly with governor fuel feed duct; 52 - distributor fuel feed duct; 53 - duct connecting acceleration control unit with governor chamber; 54 - duct connecting acceleration control unit with atmosphere;

55 - acceleration control unit valve; 56 - valve bushing; 57, 66 - membranes; 58, 65 - springs; 59 - adjusting screws; 60 - fuel return duct; 61 - air supply (at pressure P₂) corrected separately for acceleration control unit and starting control unit; 62 - duct connecting acceleration control unit with chamber of wobble plate piston; 63 - starting control unit fuel feed duct; 64 - fuel return duct; 67, 98, 101 - jets; 68 - starting control unit valve; 69 - valve seat; 70 - distributing valve; 71 - duct routing fuel to burners primary manifold; 72 - duct routing fuel to burners main manifold; 73 - burner; 74 - adjusting screw; 75 - distributing valve spring; 76 - spring of transmitter slide valve; 77 - slide valve supporting needle; 78 - wobble plate piston chamber fuel feed duct; 79 - governor fuel feed duct; 80 - return piston chamber fuel feed duct; 81 - return lever; 82 - drain holes of return slide valve bushing; 83 - fuel drain chamber; 84 - minimum pressure valve; 85 - minimum pressure valve fuel feed duct; 86 - return slide valve; 87 - duct connecting return slide valve with throttling assembly; 88 - spring of minimum pressure valve; 89 - governor slide valve sleeve; 90 - governor transmitter slide valve; 91 - support needle; 92 - centrifugal weights; 93 - return piston spring; 94 - return piston chamber; 95 - throttling assembly; 96 - return piston; 97 - inter-piston chamber; 99 - wobble plate piston; 100 - chamber of wobble plate piston; 102 - governor shaft.

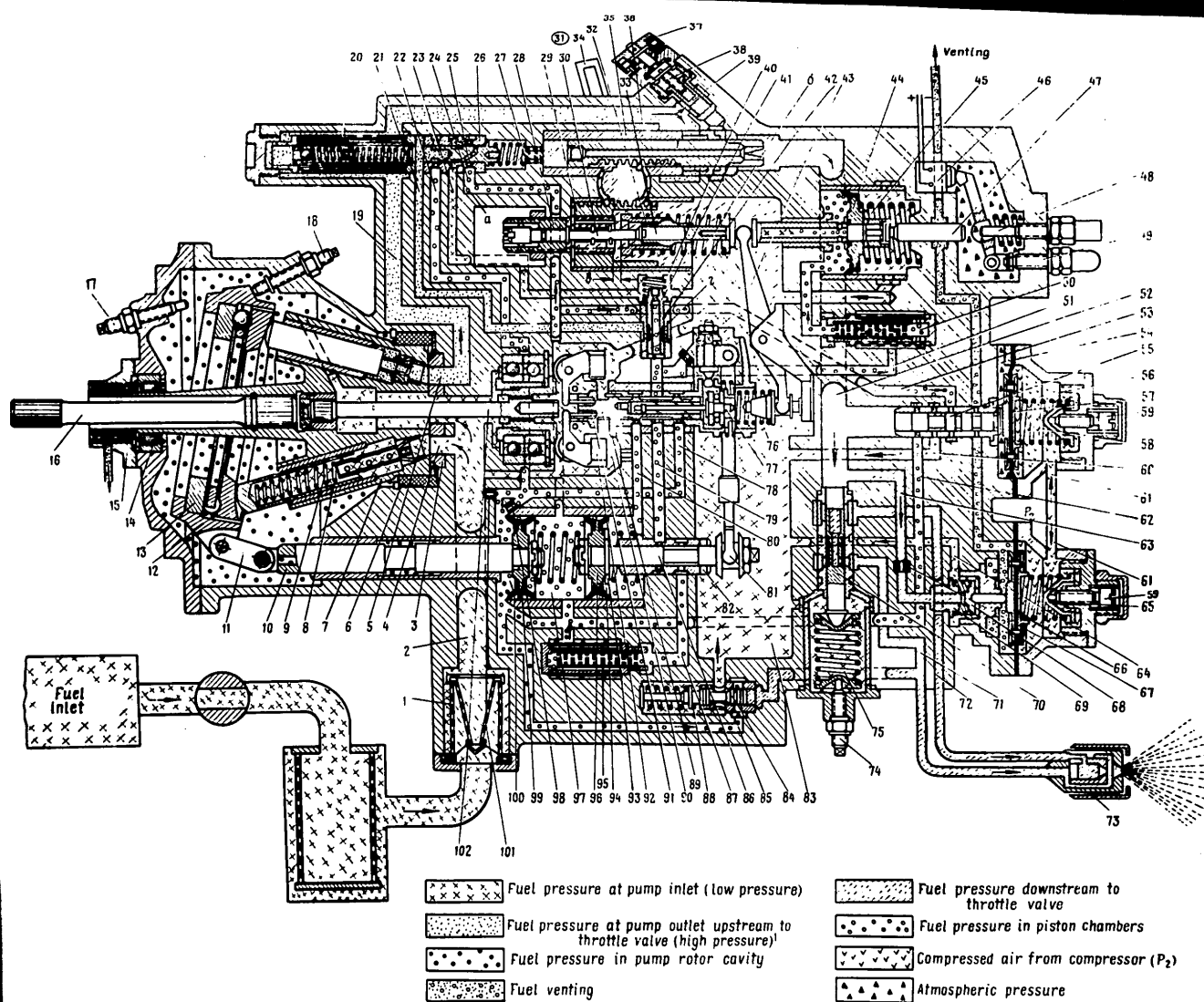


Fig. 5. HP-10A Unit Key Diagram

1 - fuel inlet filter; 2 - fuel feed duct; 3 - ported member; 4 - port in low pressure line; 5 - port in high pressure line; 6 - copper-graphite bearing; 7 - rotor; 8 - plunger; 9 - plunger spring; 10 - piston rod; 11 - link connecting piston with wobble plate; 12 - wobble plate (transmitting body); 13 - wobble plate bearing; 14 - roller bearing; 15 - gland; 16 - shaft; 17 - wobble plate minimum delivery stop screw; 18 - wobble plate maximum delivery; 19 - pump outlet duct stop screw; 20 - governor filter; 21 - duct feeding fuel into contact pressure valve; 22 - duct feeding fuel into wobble plate piston chamber; 23 - fuel return duct; 24 - duct for routing fuel from inter-piston chamber; 25 - constant pressure drop valve; 26 - valve sleeve; 27 - damper; 28 - screw for adjusting the beginning of automatic operation; 29 - nut; 30 - stop screw of decelerator rod; 31 - spring; 32 - couplings; 33 - decelerator rod; 34 - control lever; 35 - throttle valve; 36 - valve needle bushing; 37 - lifting screw adjusting head; 38 - idling rating screw; 39 - slide valve; 40 - constant pressure valve opening; 41 - constant pressure valve; 42 - valve bushing; 43 - slide valve lever; 44 - decelerator piston; 45 - piston spring; 46 - switch; 47 - rod; 48 - constant a.p.m. adjusting screw; 49 - switch adjusting screw; 50 - decelerator deceleration control; 51 - duct connecting decelerator deceleration assembly with governor deceleration control; 52 - decelerator fuel feed duct; 53 - duct connecting acceleration control unit with atmosphere; 54 - duct connecting acceleration control unit with atmosphere;

55 - acceleration control unit valve; 56 - valve bushing; 57, 66 - membranes; 58, 65 - springs; 59 - adjusting screws; 60 - fuel return duct; 61 - air supply (at pressure P_2) corrected separately for acceleration control unit and starting control unit; 62 - duct connecting acceleration control unit with chamber of wobble plate piston; 63 - starting control unit fuel feed duct; 64 - fuel return duct; 67, 98, 101 - jets; 68 - starting control unit valve; 69 - valve seat; 70 - distributing valve; 71 - duct routing fuel to burners primary manifold; 72 - duct routing fuel to burners main manifold; 73 - burner; 74 - adjusting screw; 75 - distributing valve spring; 76 - spring of transmitter slide valve; 77 - slide valve supporting needle; 78 - wobble plate piston chamber fuel feed duct; 79 - governor fuel feed duct; 80 - return piston chamber fuel feed duct; 81 - return lever; 82 - drain holes of return slide valve bushing; 83 - fuel drain chamber; 84 - minimum pressure valve; 85 - minimum pressure valve fuel feed duct; 86 - return slide valve; 87 - duct connecting return slide valve with throttling assembly; 88 - spring of minimum pressure valve; 89 - governor slide valve sleeve; 90 - governor transmitter slide valve; 91 - support needle; 92 - centrifugal weights; 93 - return piston spring; 94 - return piston chamber; 95 - throttling assembly; 96 - return piston; 97 - inter-piston chamber; 99 - wobble plate piston; 100 - chamber of wobble plate piston; 102 - governor shaft.

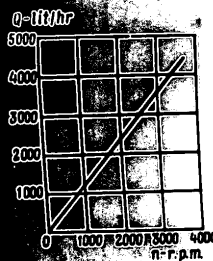


Fig. 6. Fuel Consumption versus Pump Speed at Maximum Turn of Control Lever
1 - Q kg/hr; 2 - n r.p.m.

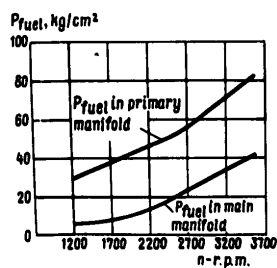


Fig. 7. Fuel Pressure in Main and Primary Manifolds versus Speed of HP-10 A Unit (throttle valve fully open)
1 - P fuel, kg/sq.cm.; 2 - P fuel in primary manifold; 3 - P fuel in main manifold; 4 - n r.p.m.

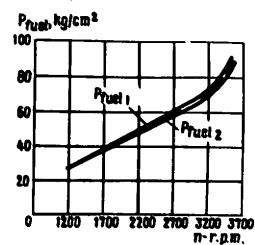
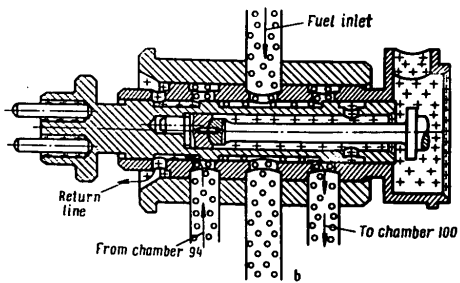
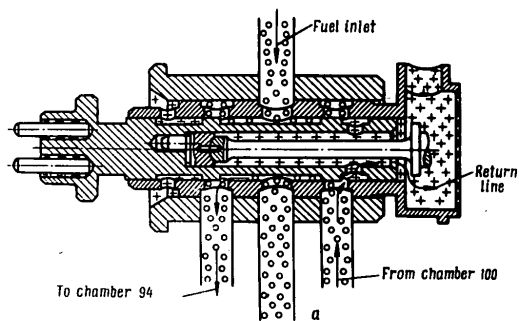
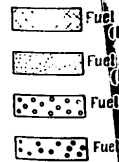
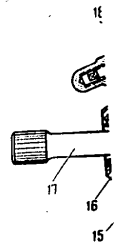


Fig. 8. Fuel Pressure Variation before Throttle Valve (P_{f1}) and after Throttle Valve (P_{f2}) versus Speed of HP-10 A Unit (throttle valve fully open)
1 - P fuel, kg/sq.cm.; 2 - P fuel;
3 - P fuel; 4 - n r.p.m.



- Fuel pressure at pump inlet (low pressure)
- Fuel pressure in piston chambers

Fig. 9. Slide Valve Transmitter Position and Fuel By-Pass with Increase or Decrease of Engine Speed from Rated Value



- 1 - protect
- of rotor
- spring; 9 -
- 13 - wobb
- bearing; 1
- 19 - wobb
- line; 20 -
- 21 - oil
- 22 - oil
- 23 - oil
- 24 - oil
- 25 - oil
- 26 - oil
- 27 - oil
- 28 - oil
- 29 - oil
- 30 - oil
- 31 - oil
- 32 - oil
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- 90 - oil
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- 95 - oil
- 96 - oil
- 97 - oil
- 98 - oil
- 99 - oil
- 100 - oil

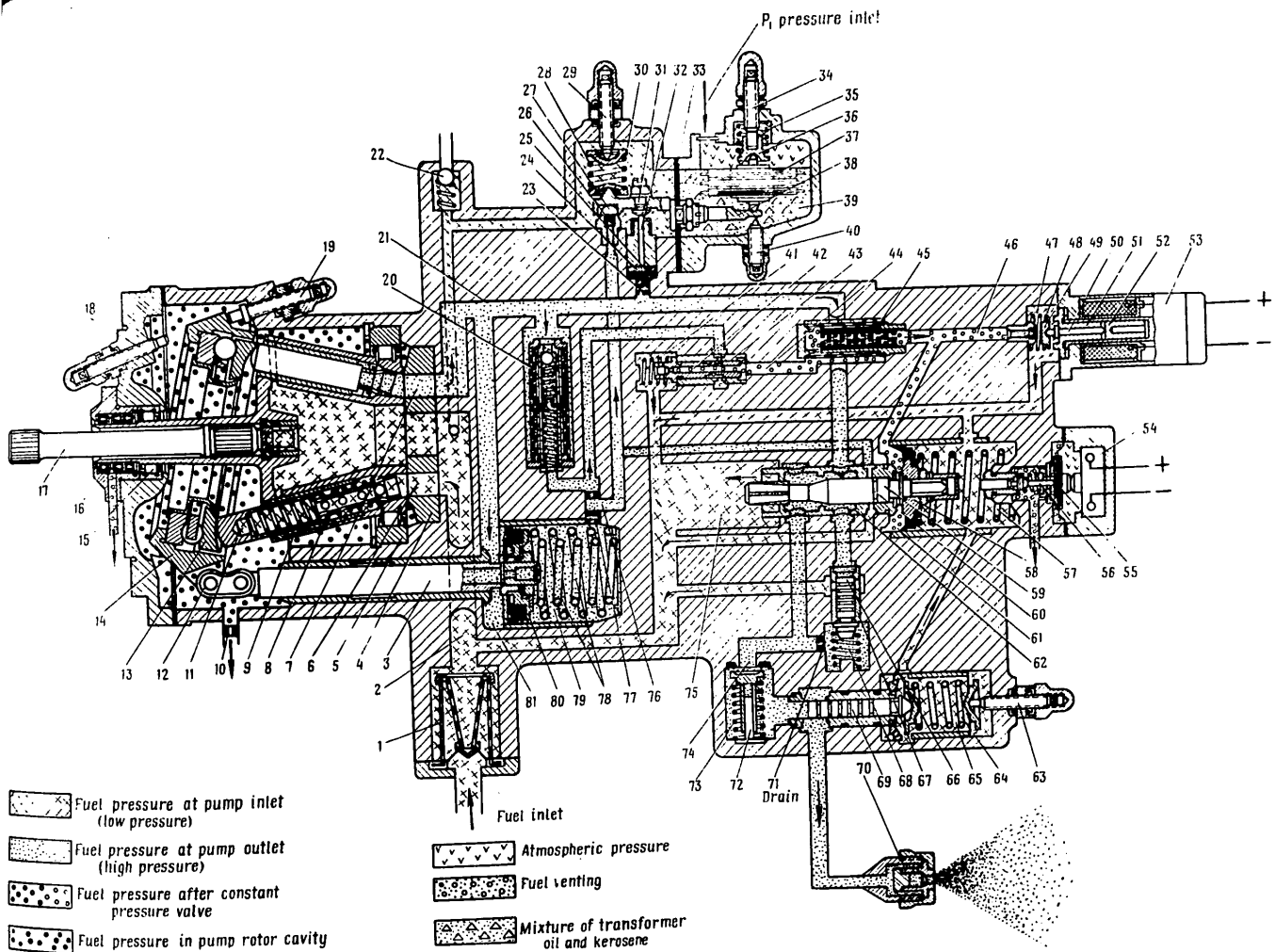


Fig. 10. Key Diagram of Unit HP-11A

1 - protective filter; 2 - pump fuel delivery duct; 3 - piston rod; 4 - ported member; 5 - ring of rotor roller bearing; 6 - port on low pressure line; 7 - port on high pressure line; 8 - plunger spring; 9 - rotor; 10 - rotor chamber fuel drain jet; 11 - plunger; 12 - piston rod link; 13 - wobble plate ball bearing; 14 - wobble plate (bearing body); 15 - rotor shank roller bearing; 16 - rotor shank gland; 17 - shaft; 18 - wobble plate minimum delivery stop screw; 19 - wobble plate maximum delivery stop screw; 20 - high pressure filter; 21 - high pressure line; 22 - air release valve; 23 - damper in line feeding fuel to barostat diaphragm; 24 - diaphragm; 25 - slide block; 26 - jet in barostat valve socket; 27 - barostat valve; 28 - valve spring; 29 - adjusting screw of barostat valve spring; 30 - valve chamber; 31 - micrometric screw; 32 - eccentric rod; 33 - elastic partition; 34 - aneroid adjusting screw; 35 - support spring; 36 - aneroid support; 37 - aneroid; 38 - valve lever; 39 - aneroid chamber; 40 - aneroid lever stop screw; 41 - constant pressure valve spring; 42 - constant pressure valve; 43 - valve

bushing; 44 - throttling assembly fuel feed duct; 45 - throttling assembly; 46 - electromagnetic valve fuel feed duct; 47 - valve seat; 48 - valve spring; 49 - valve; 50 - electromagnetic rod valve pole; 52 - core; 53 - electromagnet for cutting in afterburner valve; 54 - switch; 55 - mechanism; 56 - switch rod; 57 - spring of afterburner valve piston; 58 - piston of afterburner valve; 59 - afterburner valve sleeve; 60 - fuel by-pass groove; 61 - afterburner valve piston chamber; 62 - afterburner valve; 63 - fuel valve adjusting screw; 64 - valve bushings; 65 - valve chamber of fuel valve spring; 66 - fuel by-pass valve; 67 - valve bushings; 68 - valve spring; 69 - fuel valve; 70 - fuel burner; 71 - jet; 72 - cut-off valve; 73 - valve spring; 74 - duct delivering fuel to cut-off valve; 75 - afterburner valve cavity; 76 - jet; 77 - damper; 78 - spring of wobble plate piston; 79 - piston spring chamber; 80 - piston; 81 - piston chamber.

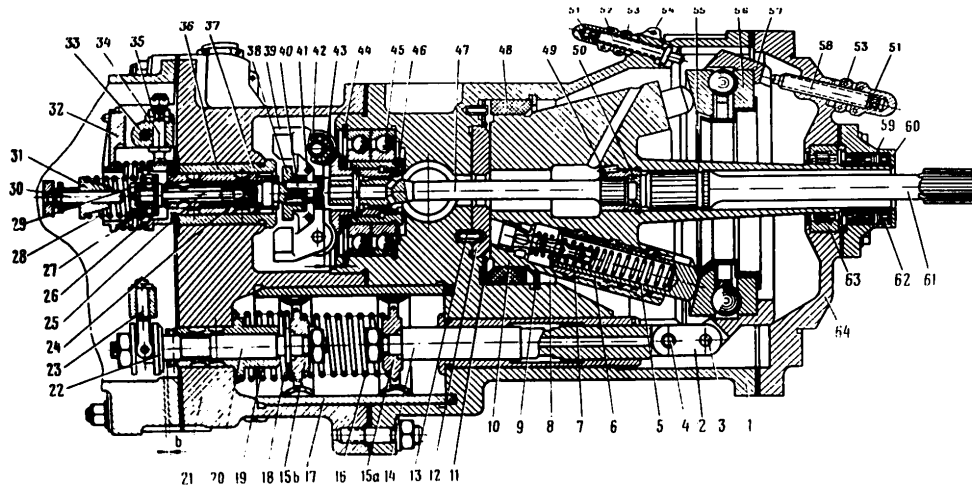


Fig. 11. HP-10A Unit. Plunger Pump and Speed Governor Units

1 - pump body; 2 - servopiston rod link; 3 - link pin; 4 - servopiston rod pin; 5 - plunger; 6 - plunger bushing; 7 - plunger spring; 8 - spring guide; 9 - lock ring; 10 - rotor; 11 - ported member lock; 12 - ported member; 13 - ported member dowel; 14 - piston rod; 15a - wobble plate piston; 15b - return slide valve piston; 16 - piston spring; 17 - piston sleeve; 18 - spring of return slide valve piston; 19 - return slide valve bushing; 20 - return slide valve; 21 - governor body; 22 - stop; 23 - slide valve fork; 24 - support of slide valve needle; 25 - slide valve needle; 26 - spring of slide valve cylinder; 27 - bearing ring of slide valve needle; 28 - spring; 29 - bearing balls of slide valve needle; 30 - pin; 31 - slide; 32 - bracket of slide valve cylinder spring and return slide valve lever; 33 - lever of return slide valve; 34 - spherical pin of return lever; 35 - slotted washer; 36 - bushing

37 - transmitter slide valve sleeve; 38 - transmitter slide valve; 39 - weights; 40 - support needle of weights; 41 - dowel of weights stop; 42 - ball bearing; 43 - weights fork; 44 - stop ring; 45 - splined bushing; 46 - coupling nut; 47 - shaft; 48 - rotor bearing; 49 - wobble plate stop screw at maximum fuel delivery; 50 - plug; 51 - cap of wobble plate stop screw; 52 - wobble plate stop screw at minimum fuel delivery; 53 - nut; 54 - packing ring; 55 - shaft lock ring; 56 - wobble plate radial-thrust bearing; 57 - bearing housing; 58 - wobble plate stop screw at minimum fuel delivery; 59 - rotor gland fuel vent ring; 60 - gland housing; 61 - shaft; 62 - gland of rotor shank; 63 - roller bearing; 64 - pump cover; a - clearance, 0.4 ± 0.05 ; b - clearance, 1 ± 0.15 .

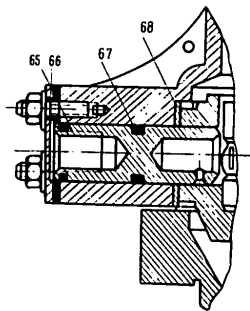


Fig. 12. Unit HP-10A. Pin of Wobble Plate Unit
65 - pin; 66 - cover; 67 - packing ring; 68 - adjusting washer;

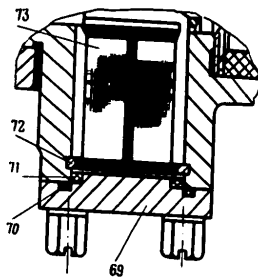


Fig. 13. Filter Unit at Pump Fuel Inlet
69 - cover of filter cavity; 70, 71 - packing rings; 72 - lock ring; 73 - filter.

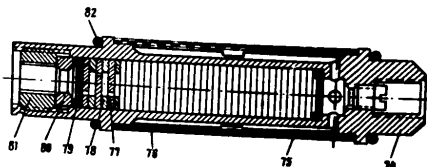


Fig. 14. Throttling Assembly
74 - throttling assembly body; 75 - frame screws; 76 - filtering screen; 77 - jets; 78 - washers; 79 - filter; 80 - distance piece; 81 - nut; 82 - packing ring.

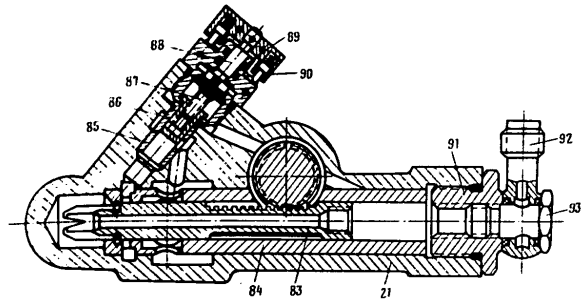


Fig. 15. HP-10A Unit
Throttle Valve and Idling Rating Valve

21 - governor body; 83 - throttle valve needle; 84 - needle bushing; 85 - idling rating valve bushing; 86 - valve; 87 - idling rating adjusting screw; 88 - pin; 89 - pipe union; 90 - idling rating valve adjusting cap; 91 - bushing of pipe union measuring pressure downstream from throttle valve; 92 - swivel nipple; 93 - pipe union.

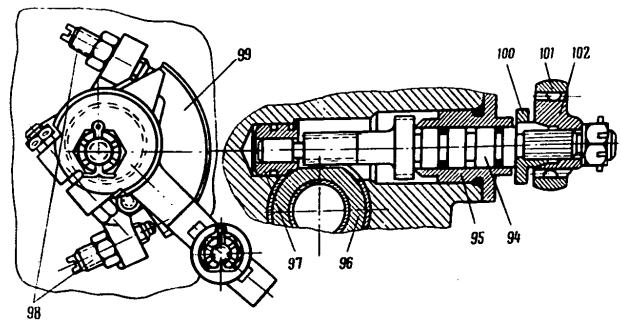


Fig. 16. HP-10A Unit
Throttle Valve Drive

94 - throttle valve control shaft; 95 - shaft bushing; 96 - hydraulic decelerator rack; 97 - shaft bushing; 98 - stop screws of throttle valve control lever; 99 - sector; 100 - limiter of throttle valve control lever; 101 - control lever; 102 - adjusting eccentric.

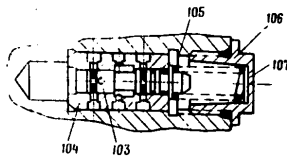


Fig. 17. HP-10A Unit, Constant Pressure Drop Valve

21 - governor body; 103 - valve plunger;
104 - bushing; 105 - spring; 106 - plug;
107 - spring adjusting washer.

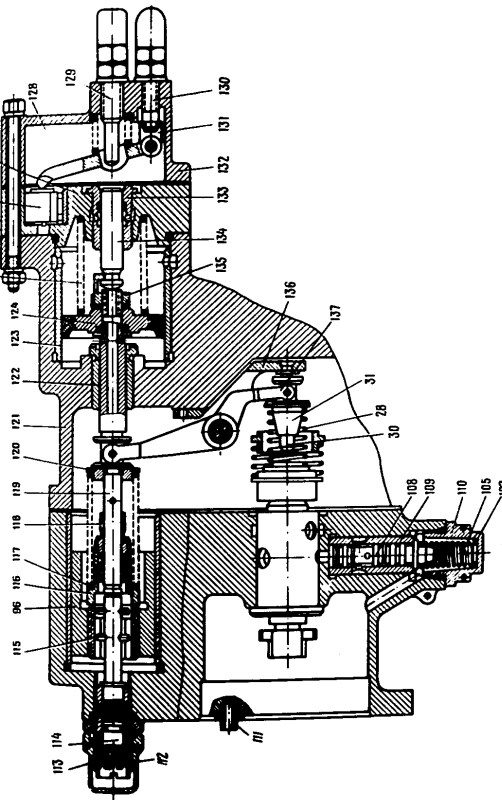


Fig. 18. HP-10A Unit Hydraulic Decelerator and Constant Pressure Valve

28 - transmitter slide valve spring; 30 - lever slide block pin of hydraulic decelerator and transmitter slide valve; 31 - slide block;
96 - rack; 109 - spring; 107 - spring adjusting washer; 108 - constant pressure valve slide valve; 109 - rack bushing; 110 - bushing;
111 - adapter sleeve; 112 - cap nut; 113 - locating threaded sleeve; 114 - stop; 115 - rack bushing; 116 - spring retainer;
117 - fuel distributor housing; 118 - fuel distributor housing; 119 - rod; 120 - spring support; 121 - fuel distributor housing;
122 - rod bushing; 123 - rod; 124 - hydraulic decelerator piston; 125 - hydraulic decelerator piston; 126 - switch;
127 - switch housing; 128 - lever; 129 - maximum pressure screw; 130 - switch adjusting screw; 131 - nut of piston;
132 - cover; 133 - rod bushing; 134 - rod; 135 - nut of piston; 136 - hydraulic decelerator and transmitter slide valve lever.

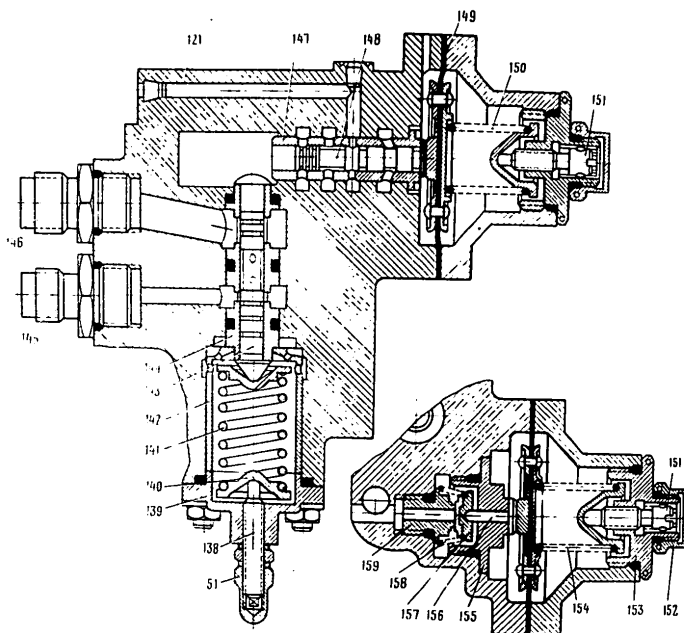


Fig. 19. HP-10A Unit. Distributing Valve, Acceleration Control Unit and Starting Control Unit
51 - cap of distributing valve adjusting screw; 121 - fuel distributor body; 138 - adjusting screw of distributing valve spring; 139 - cover; 140 - spring seat; 141 - spring; 142 - distributing valve sleeve; 143 - distributing valve plunger; 144 - bushing; 145 - pipe union feeding fuel to burners primary manifold; 146 - pipe union feeding fuel to burners secondary (main) manifold; 147 - acceleration control unit valve bushing; 148 - acceleration control unit valve; 149 - membrane; 150 - acceleration control unit spring; 151 - acceleration control unit and starting control unit adjusting screw; 152 - adjusting screw cap; 153 - pipe union; 154 - starting control unit spring; 155 - rod guide of starting control unit; 156 - valve rod; 157 - starting control unit valve; 158 - spring; 159 - valve seat.

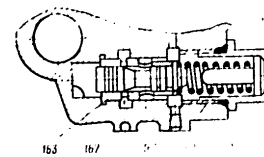


Fig. 20. HP-10A Unit. Minimum Pressure Valve

107 - spring adjusting washer; 110 - plug;
160 - minimum pressure valve stop; 161 - spring;
162 - minimum pressure valve; 163 - valve bushing; 164 - packing ring.

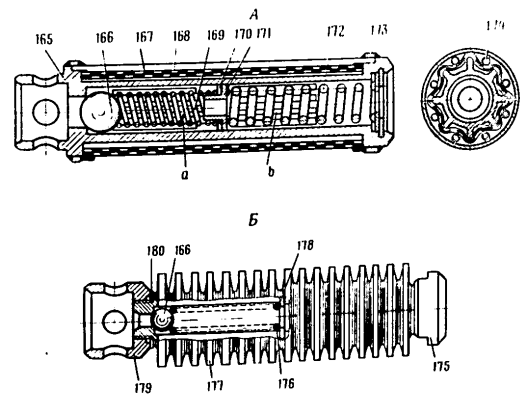


Fig. 21. High Pressure Filter

A - original model; B - modified model; 165 - filter body; 166 - ball type valve; 167 - frame screen; 168 - filtering screen; 169 - ball type valve spring; 170 - filter spring adjusting washers; 171 - spring seat; 172 - springs; 173 - ring; 174 - stud; 175 - filter body; 176 - valve springs; 177 - filtering disk; 178 - washers; 179 - bushings; 180 - adjusting washers; a and b - slots.

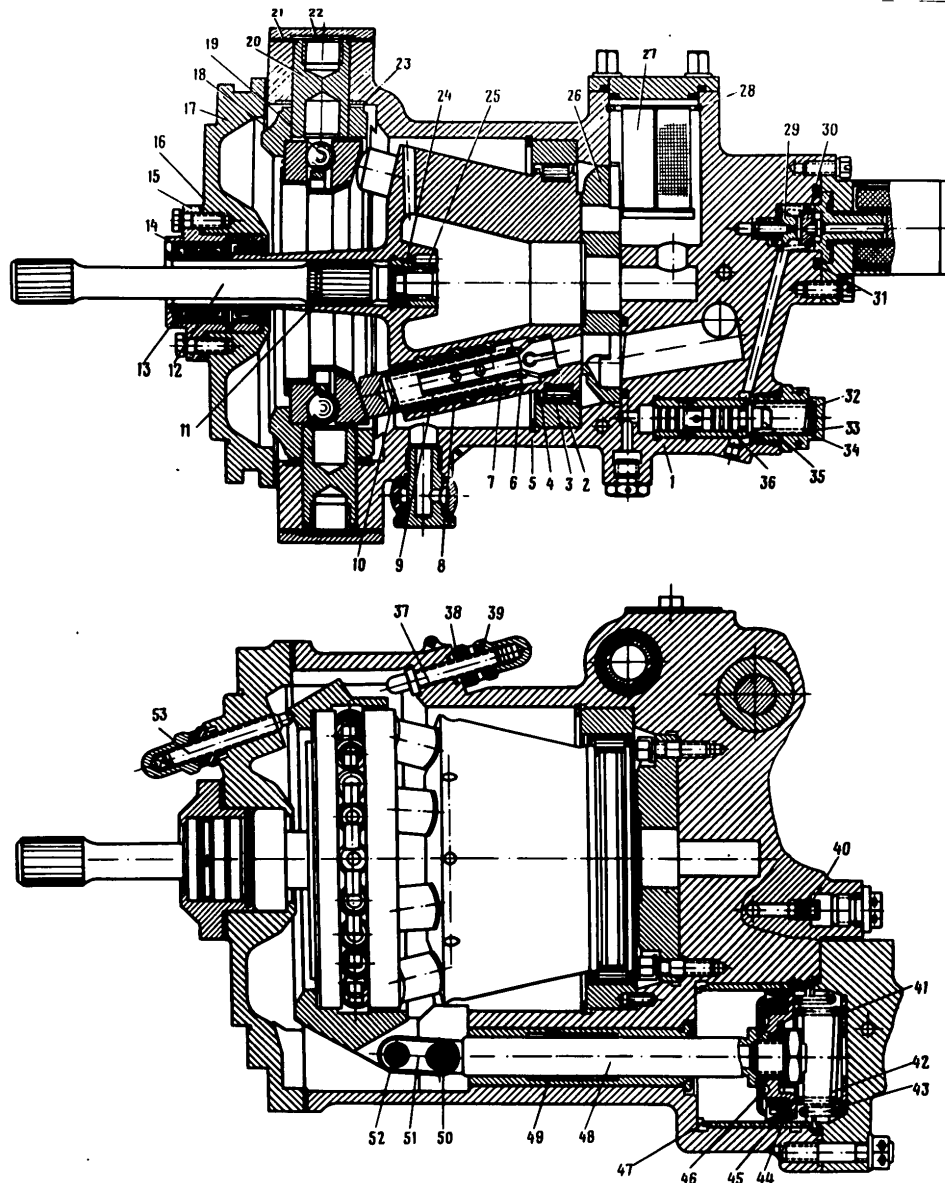


Fig. 22. HP-11A Unit. Plunger Pump, Constant Pressure Valve and Electromagnet Valve

1 - housing; 2 - race of rotor roller bearings; 3 - rollers; 4 - cages; 5 - rotor lock rings; 6 - rotor; 7 - plunger sleeve; 8 - plunger; 9 - spring guides; 10 - springs; 11 - shaft lock ring; 12 - shaft; 13 - gland; 14 - gland vent ring; 15 - gland housing; 16 - roller bearing of rotor shaft; 17 - rotor cavity cover; 18 - bearing body; 19 - bearing; 20 - wobble plate pin; 21 - pin cover gasket; 22 - cover; 23 - wobble plate adjusting washers; 24 - rotor slotted bushings; 25 - bushing attachment pin; 26 - ported member; 27 - strainer at fuel pump inlet; 28 - strainer lock ring; 29 - electromagnet valve seat; 30 - valve; 31 - electromagnet packing ring; 32 - plug; 33 - spring shim; 34 - constant pressure valve spring; 35 - plunger; 36 - valve sleeve; 37 - wobble plate maximum fuel delivery stop screw; 38 - screw nut; 39 - cap; 40 - barostat valve fuel feed jet; 41 - servopiston spring guide; 42, 43 - servopiston springs; 44 - piston (steel disc); 45 - cup; 46 - piston cup expanding plate; 47 - piston sleeve; 48 - piston rod; 49 - rod bushing; 50 - rod pin; 51 - link; 52 - pin connecting link with wobble plate; 53 - wobble plate minimum fuel delivery stop screw.

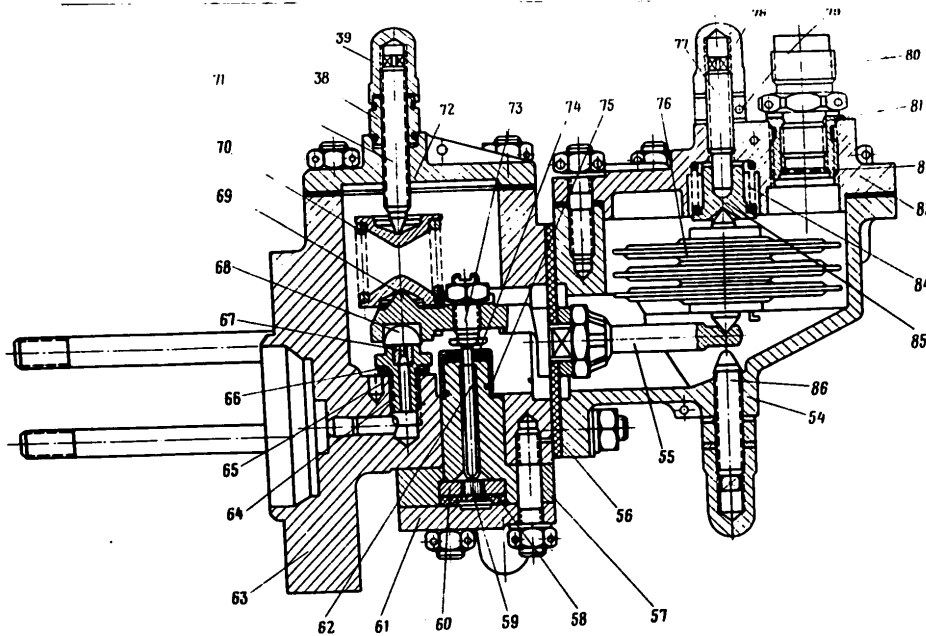


Fig. 23. HP-11A Unit Barostat

38 - adjusting screw nut; 39 - cap; 54 - aneroid housing; 55 - lever; 56 - elastic partition; 57 - diaphragm body (eccentric); 58 - diaphragm; 59 - retainer block; 60 - ring; 61 - diaphragm cover; 62 - rod; 63 - housing; 64 - valve seat; 65 - lock; 66 - shim; 67 - valve seat jet nozzle; 68 - valve; 69 - valve spring seat; 70 - spring; 71 - valve adjusting screw; 72 - valve cavity cover; 73 - rod limit (micrometric screw); 74 - rod gland; 75 - gland cap; 76 - aneroid; 77 - aneroid adjusting screw; 78 - cap; 79 - nut; 80 - air inlet pipe union; 81 - bushing; 82 - filter gauze; 83 - aneroid housing cover; 84 - spring; 85 - spring support; 86 - lever stop screw.

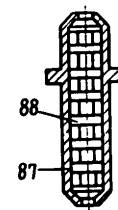


Fig. 24. HP-11A Unit Damper

87 - damper sleeve;
88 - damper.

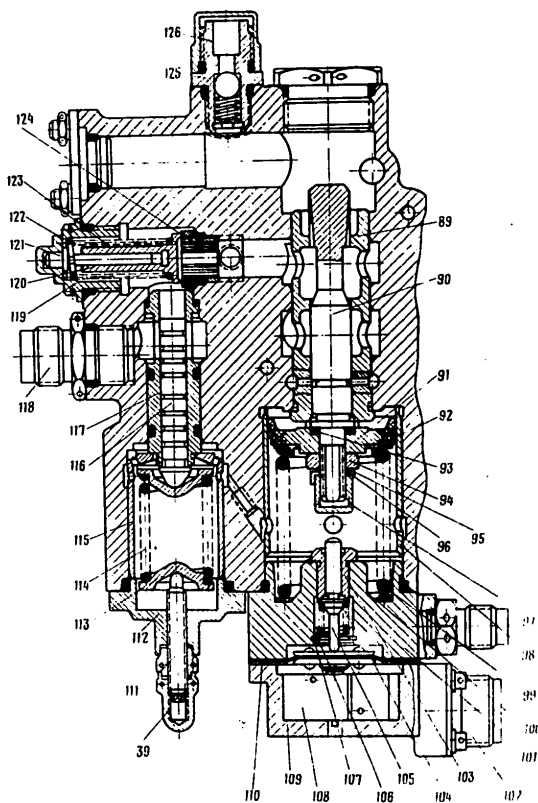


Fig. 25. Afterburner Valve, Electric Switch, Fuel Valve and Cut-Off Valve Units

39 - cap of fuel valve adjusting screw; 89 - afterburner valve sleeve;
90 - afterburner valve; 91 - piston; 92 - spring support; 93 - piston packing rings; 94 - nut; 95 - adjusting washer; 96 - lock; 97 - cap; 98 - piston sleeve;
99 - spring; 100 - washer; 101 - switch housing; 102 - connector plug; 103 - sleeve; 104 - spring; 105 - switch rod; 106 - spring support; 107 - spring ring; 108 - switch K8-6; 109 - cover; 110 - diaphragm; 111 - fuel valve spring adjusting screw; 112 - cover; 113 - spring retainer; 114 - spring; 115 - spring cup; 116 - fuel valve plunger; 117 - sleeve; 118 - pipe union feeding fuel to burner; 119 - plug of cut-off valve rod; 120 - sleeve of cut-off valve rod; 121 - rod; 122 - spring washer; 123 - spring; 124 - cut-off valve seat; 125 - ball type valve; 126 - air relief valve pipe union.

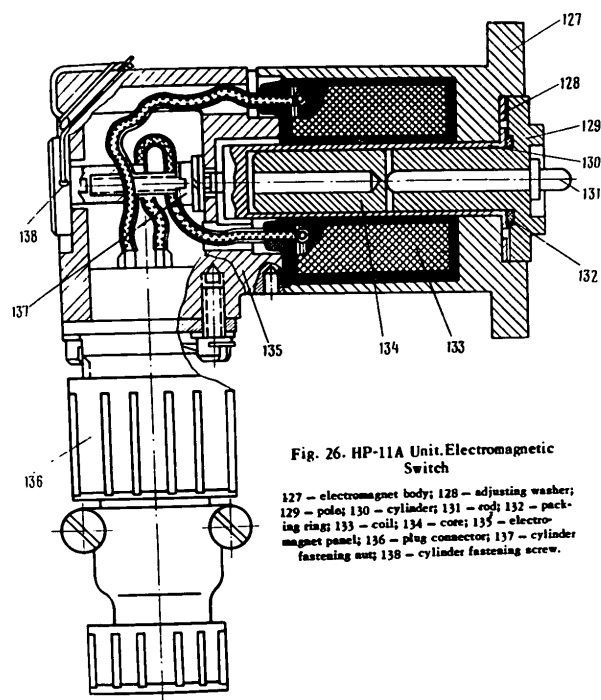


Fig. 26. HP-11A Unit. Electromagnetic Switch

127 - electromagnet body; 128 - adjusting washer; 129 - pole; 130 - cylinder; 131 - rod; 132 - packing ring; 133 - coil; 134 - core; 135 - electromagnet panel; 136 - plug connector; 137 - cylinder fastening nut; 138 - cylinder fastening screw.

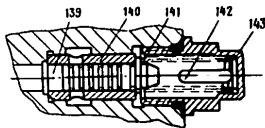


Fig. 27. HP-11A Unit, Fuel By-Pass Valve

139 - plunger; 140 - plunger sleeve;
141 - spring; 142 - valve stop;
143 - plug.

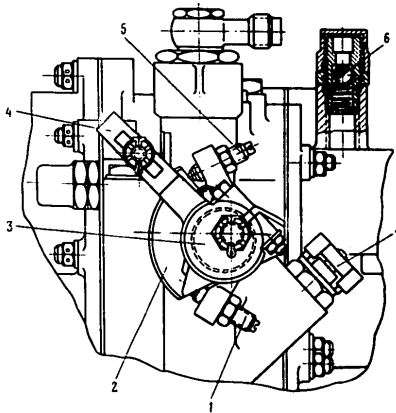


Fig. 28. Throttle Valve Lever, Idling Rating Valve and Air Relief Valve Units

1 - lever stop screw at CUT-OFF (CTOP) position; 2 - sector;
3 - control lever hub; 4 - control lever; 5 - stop screw of throttle valve lever at FULL THROTTLE (TO/WHEN PAS) position;
6 - air relief valve; 7 - head of low throttle valve screw.

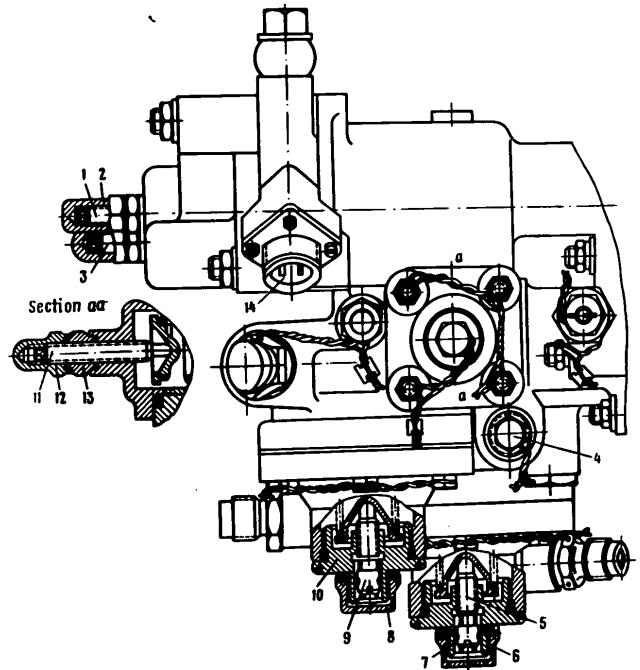


Fig. 29. Acceleration Control Unit, Starting Control Unit, Distributing Valve and Decelerator

1 - screw regulating maximum r.p.m.; 2 - screw cap; 3 - adjusting screw of limit switch;
4 - decelerator throttling assembly; 5 - adjusting screw of acceleration control unit membrane spring; 6 - cap; 7 - pipe union; 8 - cap of adjusting screw of starting control unit membrane spring; 9 - adjusting screw of starting control unit membrane spring; 10 - pipe union;
11 - adjusting screw of distributing valve; 12 - screw cap; 13 - nut; 14 - limit switch plug.

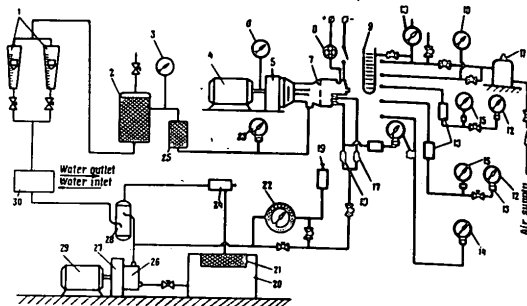


Fig. 30. Diagram of Stand for Testing HP-10A Unit

1 - rotameters, $Q = 150 - 4500$ lit/hr; 2 - filter made of opacal fabric; 3 - thermometer, measuring range from 0 to 125°C ; 4 - electric motor; 5 - reduction gear; 6 - T3-20 mechanism; 7 - unit under test; 8 - electric bulb; 9 - 500 mm Hg piezometer; 10 - pressure gauge, measuring range from 0 to 50 kg/cm²; 11 - reducing valve; 12 - pressure gauge, measuring range from 0 to 60 kg/cm²; 13 - damper; 14 - pressure gauge, measuring range from 0 to 25 kg/cm²; 15 - pressure gauge, measuring range from 0 to 160 kg/cm²; 16 - gauge with 17 - main manifold jet ($Q = 3520$ lit/hr, at $P_{\text{fuel}} = 40$ kg/cm²); 18 - jet equal in capacity to primary manifold burner of $Q = 455$ lit/hr, at $P_{\text{fuel}} = 30$ kg/cm²; 19 - safety valve rated for 100 - 140 kg/cm²; 20 - service tank; 21 - carbide filter; 22 - flowmeter $Q = 150 - 4500$ lit/hr; 23 - pressure gauge, measuring range from 0 to 10 kg/cm²; 24 - reducing valve; 25 - gauge filter; 26 - booster pump; 27 - reduction gear; 28 - de-aerator; 29 - electric motor; 30 - radiator.

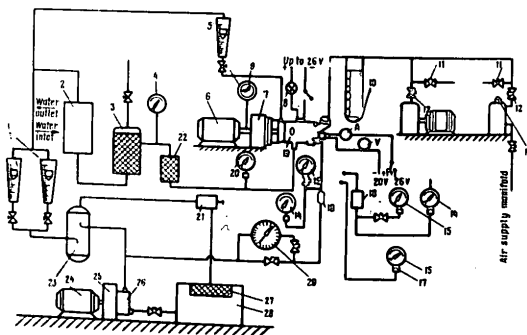


Fig. 31. HP-11A Unit Test Stand

1 - rotameters, $Q = 150 - 4500$ lit/hr; 2 - radiator; 3 - filter of opacal fabric; 4 - electric motor, measuring range from 0 to 125°C ; 5 - flowmeter $Q = 250 - 750$ lit/hr; 6 - electric motor; 7 - unit under test; 8 - bulb; 9 - mechanism T3-20; 10 - piezometer, 1250 mm Hg; 11 - filter-adjustment valve; 12 - needle valve; 13 - reduction valve $P_0 = 1200$ mm Hg, absolute; 14 - pressure gauge measuring range from 0 to 160 kg/cm²; 15 - pressure gauge, measuring range from 0 to 25 kg/cm²; 16 - gauge with 17 - jet, equal in capacity to main manifold jet of $Q = 3700 \pm 40$ lit/hr at $P_{\text{fuel}} = 50$ kg/cm²; 18 - jet, equal in capacity to main manifold jet of $Q = 455$ lit/hr at $P_{\text{fuel}} = 30$ kg/cm²; 19 - safety valve rated for 100 - 140 kg/cm²; 20 - service tank; 21 - carbide filter; 22 - flowmeter $Q = 150 - 4500$ lit/hr; 23 - pressure gauge, measuring range from 0 to 10 kg/cm²; 24 - reducing valve; 25 - gauge filter; 26 - booster pump; 27 - reduction gear; 28 - de-aerator; 29 - electric motor; 30 - radiator.

Fig. 32 section

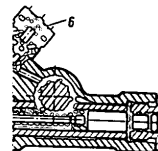


Fig. 32

Fig. 32

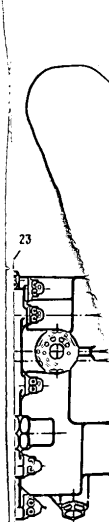


Fig. 32

Fig. 32 is a schematic diagram of a hydraulic testing apparatus, showing a central unit (7) connected to various components including flowmeters (1), filters (2), a thermometer (3), an electric motor (4), a pressure gauge (10), a pressure gauge (12), a pressure gauge (13), a pressure gauge (14), a pressure gauge (15), a pressure gauge (16), a pressure gauge (17), a pressure gauge (18), a pressure gauge (19), a pressure gauge (20), a pressure gauge (21), a pressure gauge (22), a pressure gauge (23), a pressure gauge (24), a pressure gauge (25), a pressure gauge (26), a pressure gauge (27), a pressure gauge (28), a pressure gauge (29), and a pressure gauge (30). The diagram also shows a water outlet, a water inlet, and an air supply.

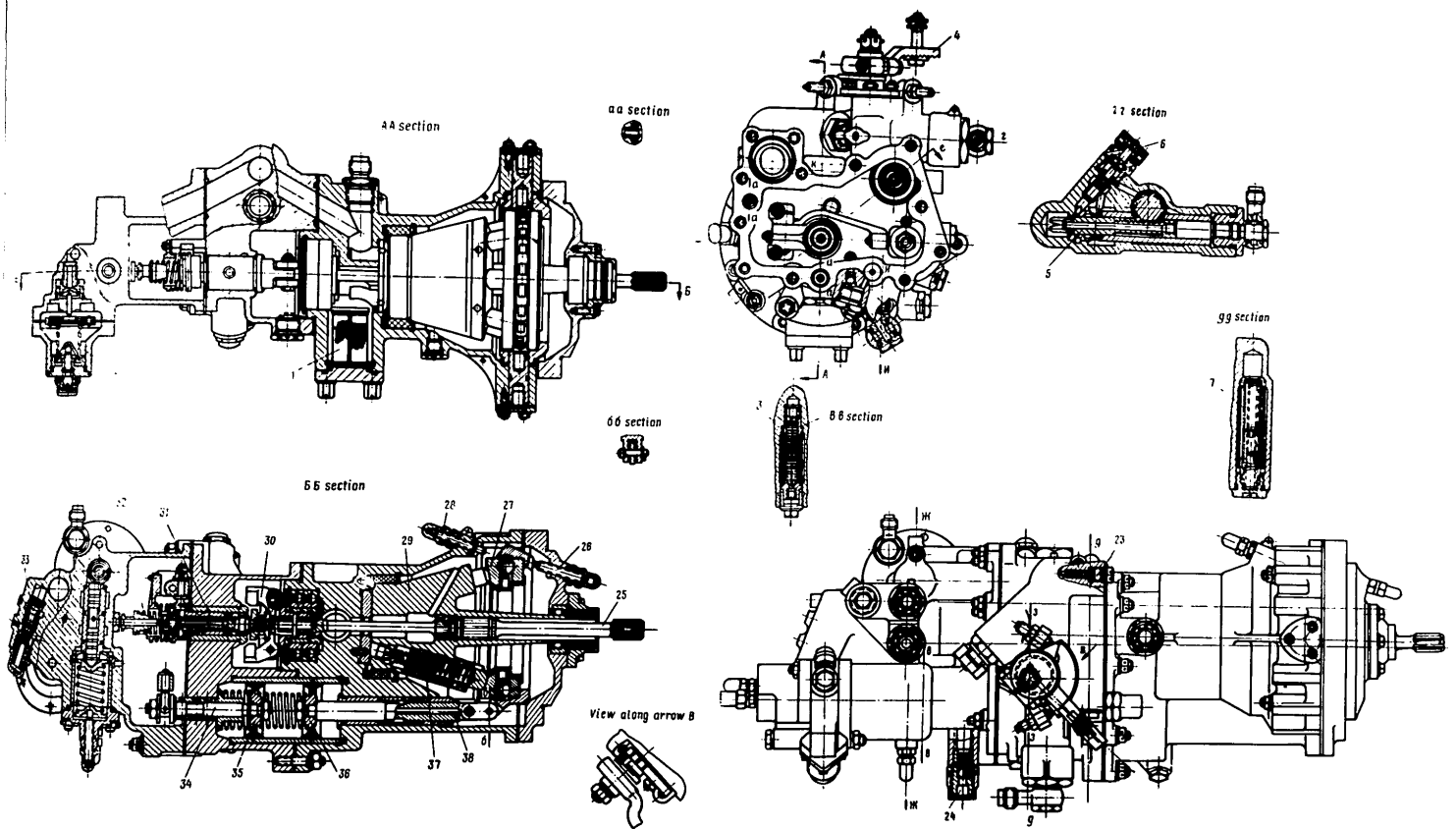
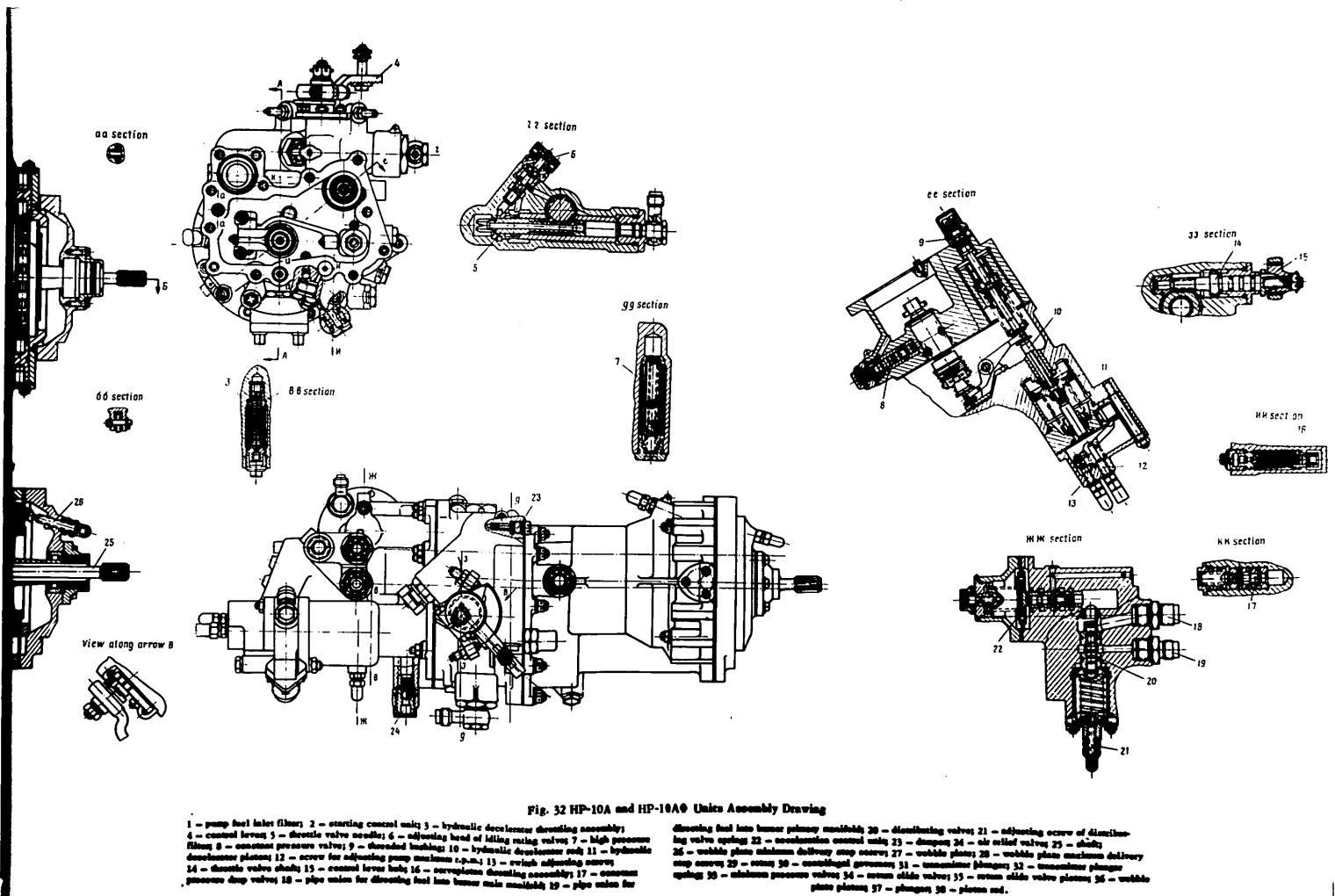


Fig. 32 HP-10A and HP-10A9 Units Assembly Drawing

1 - pump fuel inlet filter; 2 - starting control unit; 3 - hydraulic decelerator throttling assembly; 4 - control lever; 5 - throttle valve needle; 6 - adjusting head of idling mixing valve; 7 - high pressure filter; 8 - constant pressure valve; 9 - threaded bushing; 10 - hydraulic decelerator shaft; 11 - hydraulic decelerator plates; 12 - screws for adjusting pump maximum r.p.m.; 13 - velocity adjusting screws; 14 - throttle valve shaft; 15 - control lever bush; 16 - corrugated throttling assembly; 17 - constant pressure drop valve; 18 - pipe union for directing fuel into burner main manifold; 19 - pipe union for

directing fuel into burner primary manifold; 20 - valve spring; 21 - accumulation control; 22 - wobble plate minimum delivery stop screw; 23 - screw; 24 - control lever; 25 - springs; 26 - minimum pressure valve; 27 -



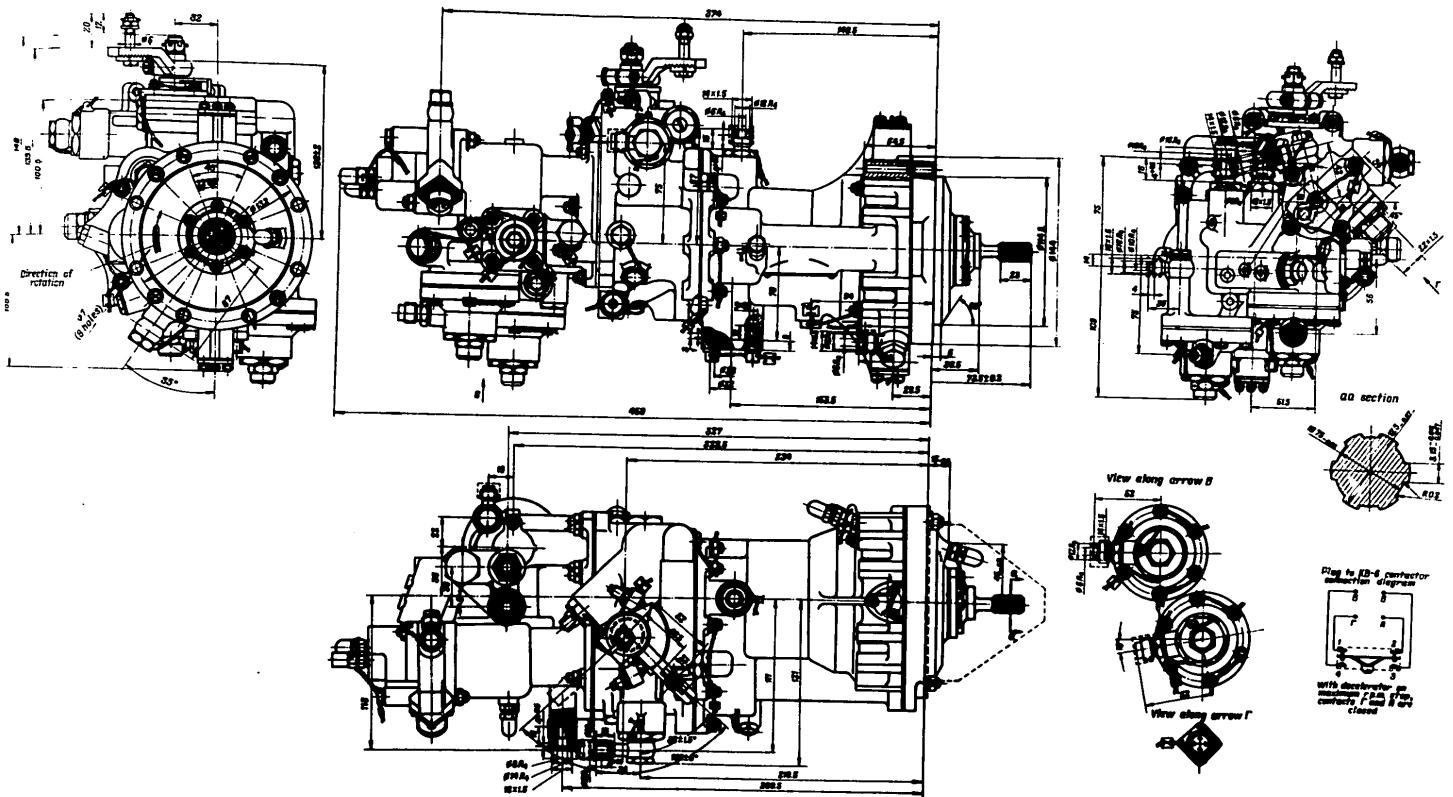


Fig. 93. Unit HP-10A Dimensional Drawing

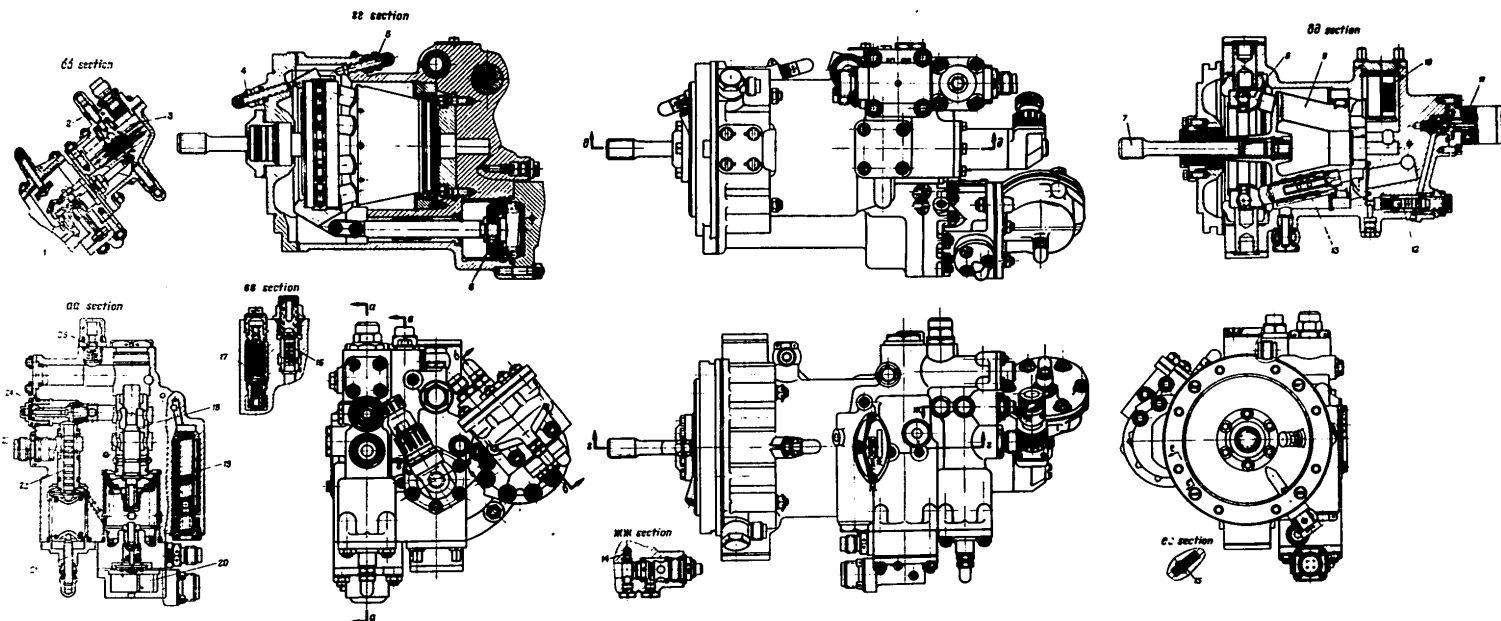
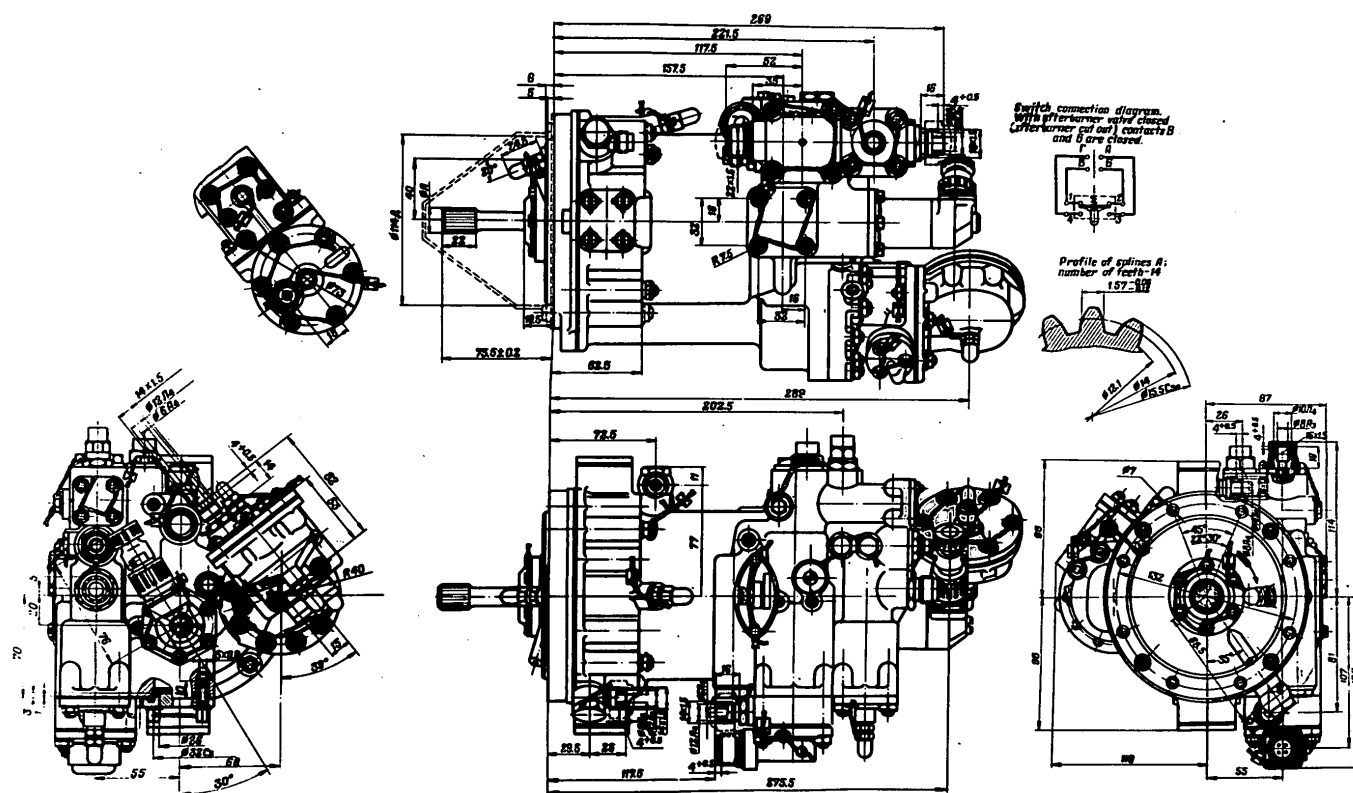


Fig. 34. HP-11A and HF-11A Units Assembly Drawing

- 1 - barostat valve; 2 - aneroid adjusting screw; 3 - aneroid; 4 - screw adjusting minimum fuel delivery;
 5 - screw adjusting maximum fuel delivery; 6 - servopiston; 7 - shaft; 8 - valve plate; 9 - cone; 10 - fuel
 inlet filter; 11 - electromagnet; 12 - constant pressure valve; 13 - plunger; 14 - damper; 15 - damper;
 16 - fuel bypass valve; 17 - check valve; 18 - check valve; 19 - high pressure filter; 20 - outside;
 21 - adjusting screw of distributing valve; 22 - distributing valve; 23 - pipe union supplying fuel to burner;
 24 - cut-off valve; 25 - air bleed valve.



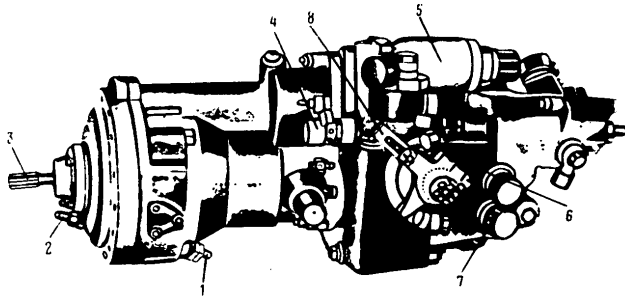


Fig. 36. HP-10AKC Unit, View on Control Lever

1 - cap of stop screw of wobble plate maximum delivery; 2 - cap of stop screw of wobble plate minimum delivery; 3 - shaft; 4 - cap of screw adjusting the beginning of automatic operation; 5 - electromagnet unit MKO-M; 6 - pipe union supplying fuel to burner primary manifold; 7 - pipe union supplying fuel into burner main manifold; 8 - control lever.

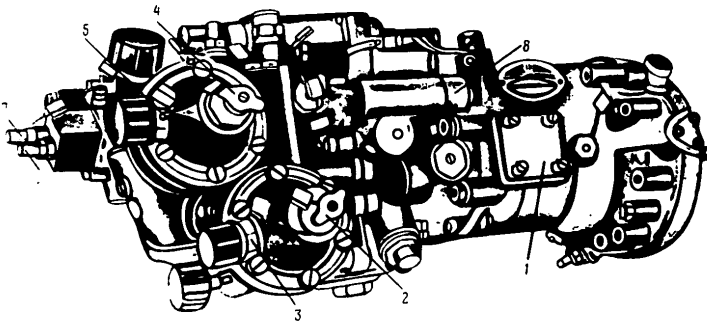


Fig. 37. HP-10AKC Unit, View on Fuel Supply Connection

1 - cover of fuel supply cavity; 2 - cap of acceleration control unit adjusting screw; 3 - pipe unions delivering air under pressure P_2 corrected by pressure relief jet; 4 - cap of starting control unit adjusting screw; 5 - cap of switch adjusting screw; 6 - cap of maximum r.p.m. adjusting screw; 7 - cap of maximum r.p.m. adjusting screw; 8 - throttling assembly regulating wobble plate turning rate.

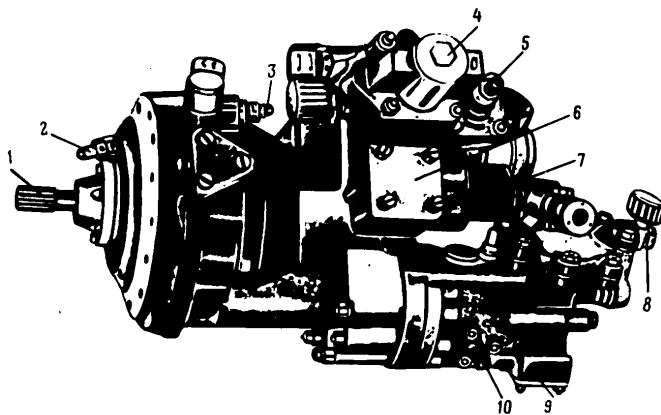


Fig. 38. HP-11BA Unit. View on Fuel Supply Connection

1 - shaft; 2 - cap of screw adjusting minimum output; 3 - cap of screw adjusting maximum output; 4 - plug of interlocking device switch screw; 5 - cap of fuel valve screw; 6 - cover of fuel delivery cavity; 7 - electromagnetic switch; 8 - pipe union delivering gases at pressure P_4 ; 9 - cover of afterburner adjusting mechanism; 10 - barostat eccentric cover.

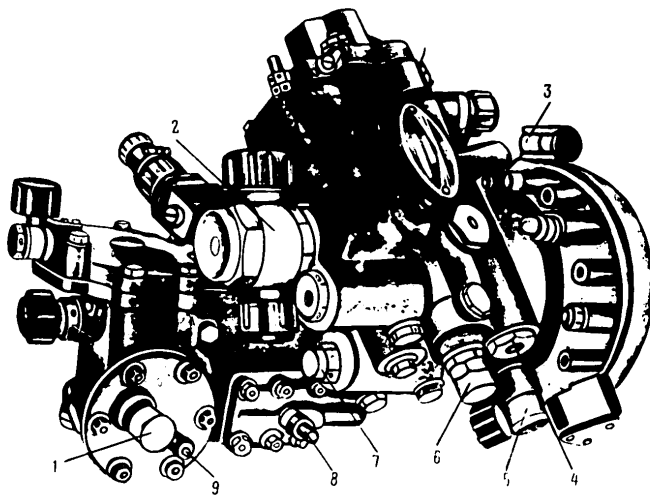


Fig. 39. Unit HP-11BA. View on Barostat

1 - pipe union feeding air to barostat aneroid chamber; 2 - pipe union supplying fuel to burners; 3 - fuel drain pipe union; 4 - high pressure filter; 5 - pipe union by-passing fuel to HP-10AKC unit inlet; 6 - unit air bleed valve; 7 - constant pressure valve plug; 8 - cap of barostat spring adjusting screw; 9 - cap of barostat aneroid adjusting screw.

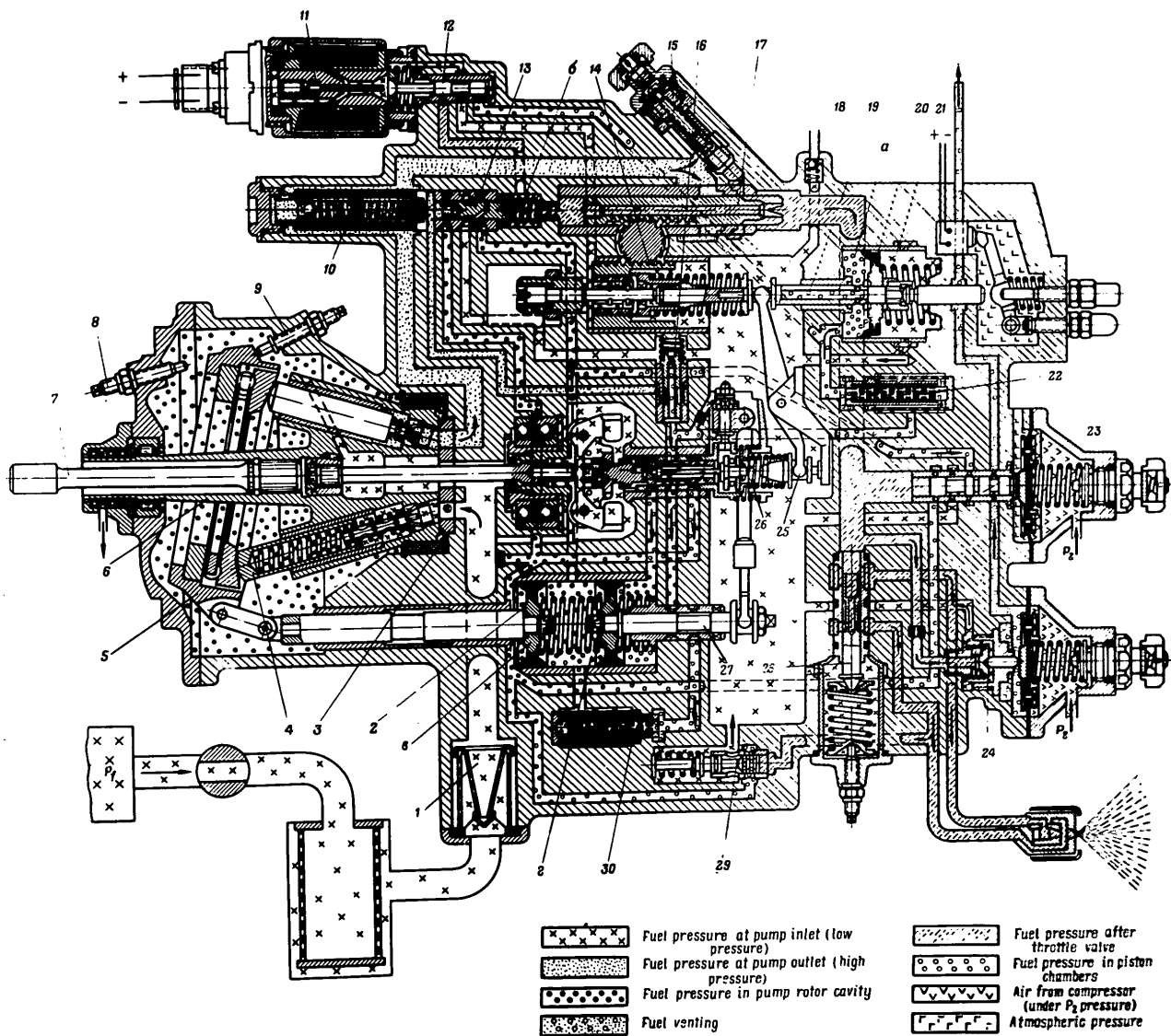


Fig. 40. Unit HP-10AKC Key Diagram

1 - unit inlet strainer; 2 - wobble plate servopiston; 3 - rotor slide valve; 4 - plunger; 5 - wobble plate; 6 - rotor; 7 - rotor shaft; 8 - minimum fuel delivery screw; 9 - maximum fuel delivery screw; 10 - fine filter; 11 - electromagnet MKO-M; 12 - fuel return valve; 13 - constant pressure drop valve; 14 - drive shaft; 15 - idling relief valve; 16 - constant pressure valve; 17 - air bleed valve; 18 - air bleed valve; 19 - hydraulic decelerator

shaft; 20 - hydraulic decelerator servopiston; 21 - spring of hydraulic decelerator servopiston; 22 - hydraulic decelerator throttling assembly; 23 - acceleration control valve; 24 - control unit valve; 25 - hydraulic decelerator lever; 26 - transducer spring; 27 - return control unit valve; 28 - fuel valve (distributing); 29 - minimum pressure valve; 30 - throttling assembly of wobble plate servopiston.

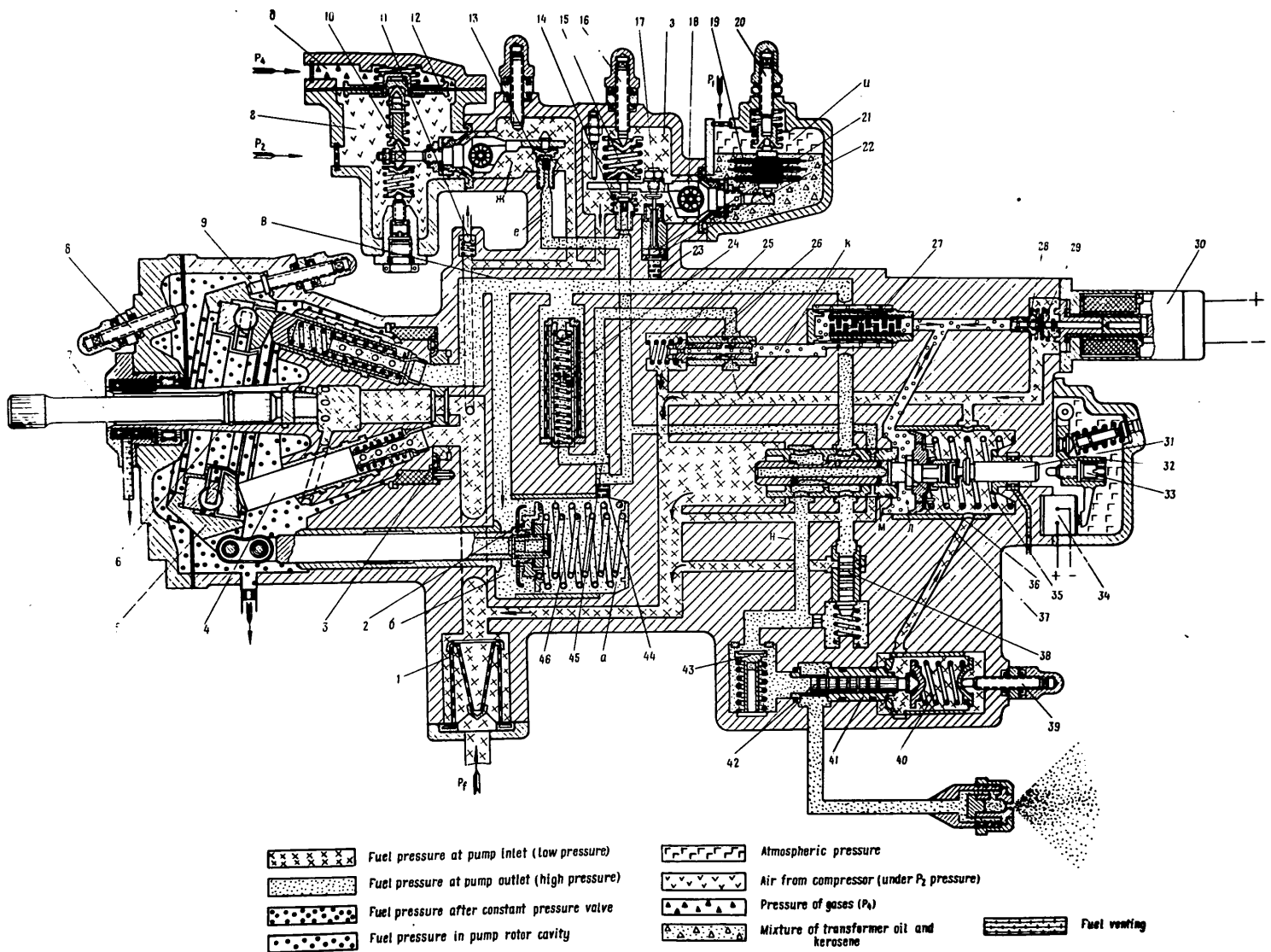
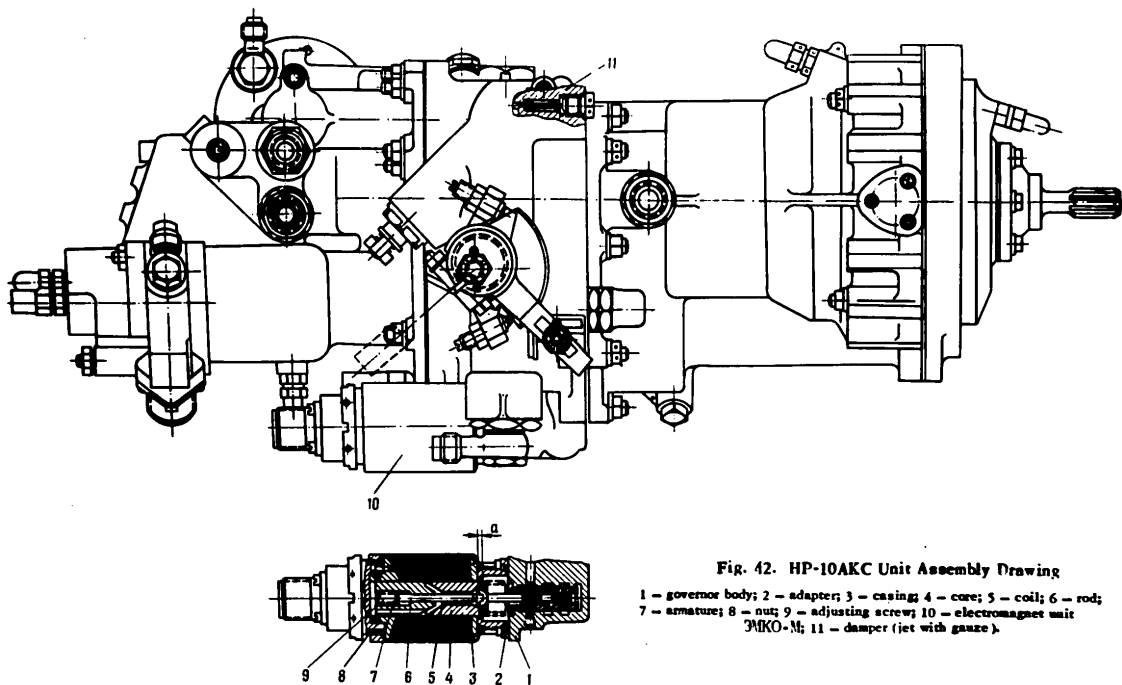


Fig. 41. IIP-11BA Unit Key Diagram

1 - unit inlet fuel strainer; 2 - wobble plate servopiston; 3 - rotor slide valve; 4 - plunger; 5 - wobble plate; 6 - rotor; 7 - rotor shaft; 8 - screw of minimum fuel delivery; 9 - screw of maximum fuel delivery; 10 - afterburner governor lever; 11 - air bleed valve; 12 - afterburner governor membrane; 13 - afterburner governor valve; 14 - barostat valve; 15 - barostat valve spring; 16 - barostat valve adjusting screw; 17 - micrometric screw; 18 - barostat lever; 19 - aneroid; 20 - aneroid adjusting screw; 21 - transmitter slide; 22 - transmitter membrane; 23 - transmitter damper; 24 - fine filter; 25 - constant

pressure valve spring; 26 - constant pressure valve; 27 - throttling assembly; 28 - electromagnet valve spring; 29 - electromagnet valve; 30 - electromagnet; 31 - switch rod; 32 - switch lever; 33 - switch adjusting screw; 34 - switch; 35 - spring of afterburner valve servopiston; 36 - afterburner valve; 37 - afterburner valve servopiston; 38 - bypass valve; 39 - fuel valve adjusting screw; 40 - fuel valve spring; 41 - fuel valve bushings; 42 - fuel valve; 43 - cut-off valve; 44 - wobble plate servopiston damper; 45 - jet; 46 - wobble plate servopiston springs.



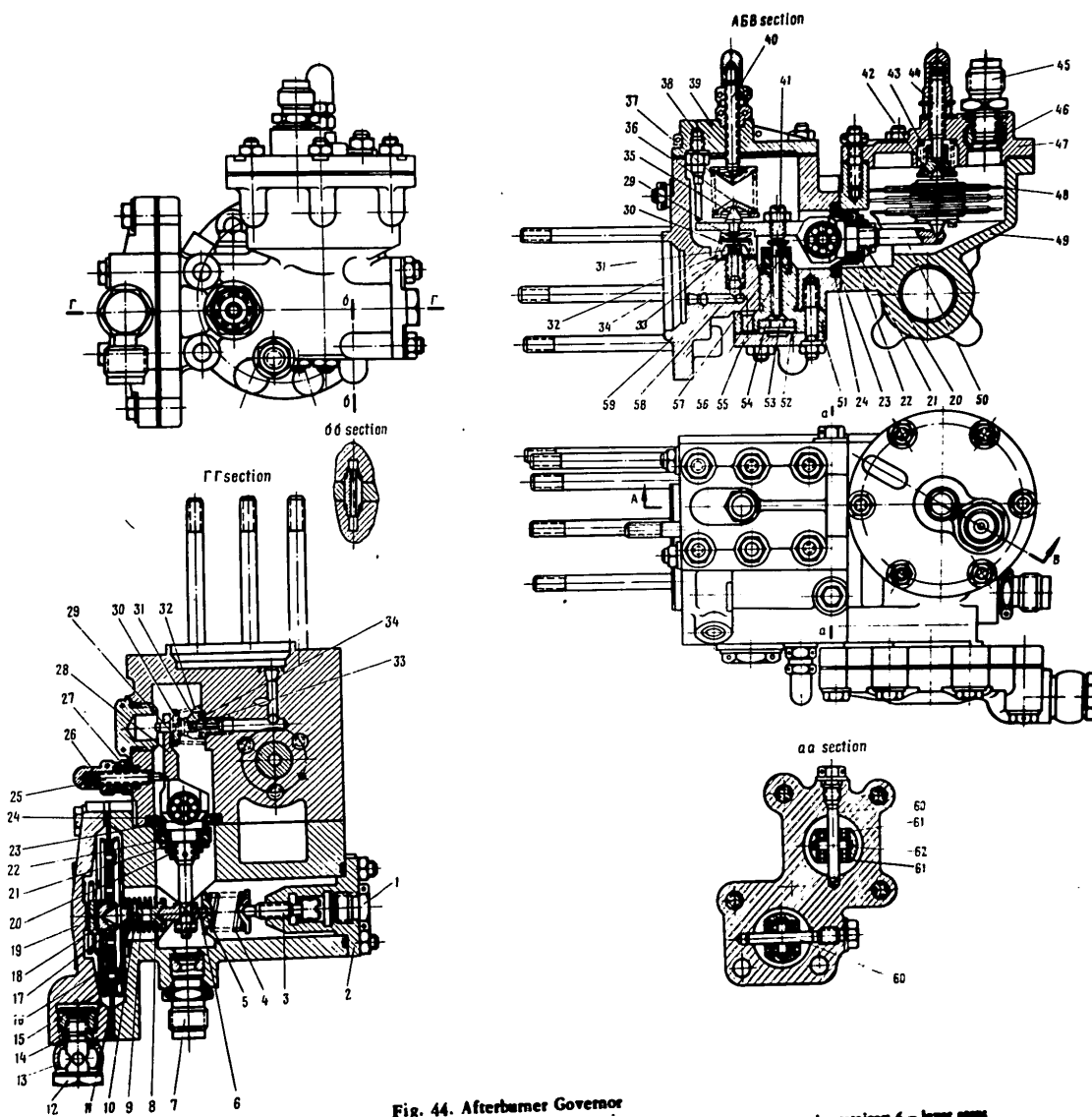


Fig. 44. Afterburner Governor

- 1 - plugs; 2 and 55 - covers; 3 - adjusting screw of afterburner governor; 4, 10, 32, 37, 43 - springs; 5 - spring retainers; 6 - lever stops; 7 - pipe union supplying pressure P_2 ; 8, 56 - rods; 9 - sleeve; 11 - bushings; 12 - pipe union; 13 - nipple supplying pressure P_1 ; 14 - threaded bushing with screws; 15, 18 - membrane discs; 16 - membrane; 17 - pin; 19 - membrane cover; 20, 27 - nuts; 21, 23 - washers; 22 - holder; 24 - lever cup; 25 - governor lever stops; 26, 58 - caps; 28 - governor lever; 29 - valve; 30 - jet; 31 - valve seats; 32 - bush; 33 - valve seat shim; 34 - stop on lever; 35 - spring guide; 36 - spring; 37 - barostat lever stops; 38 - barostat lever; 39 - barostat cover; 40 - adjusting screw; 41 - anoroid cover; 42 - anoroid; 43 - anoroid housing; 44 - anoroid adjusting screw; 45 - air feeding pipe union; 46 - anoroid; 47 - anoroid cover; 48 - anoroid; 49 - anoroid housing; 50 - barostat lever; 51 - diaphragm body; 52 - rubber diaphragm; 53 - blocks; 54 - rings; 55 - rubber glands; 56 - governor body; 60 - pin; 61 - ball bearings; 62 - spacer ring.

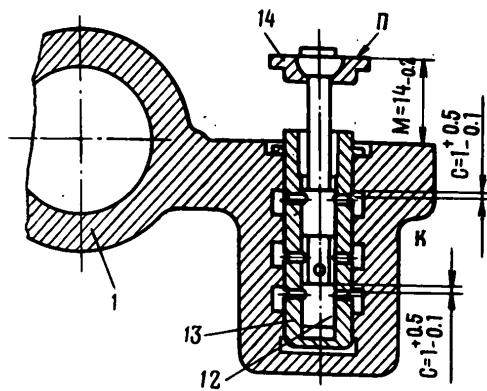


Fig. 43. Fuel Return Valve

1 - governor body; 12 - slide valve; 13 - bushing; 14 - spring guide.

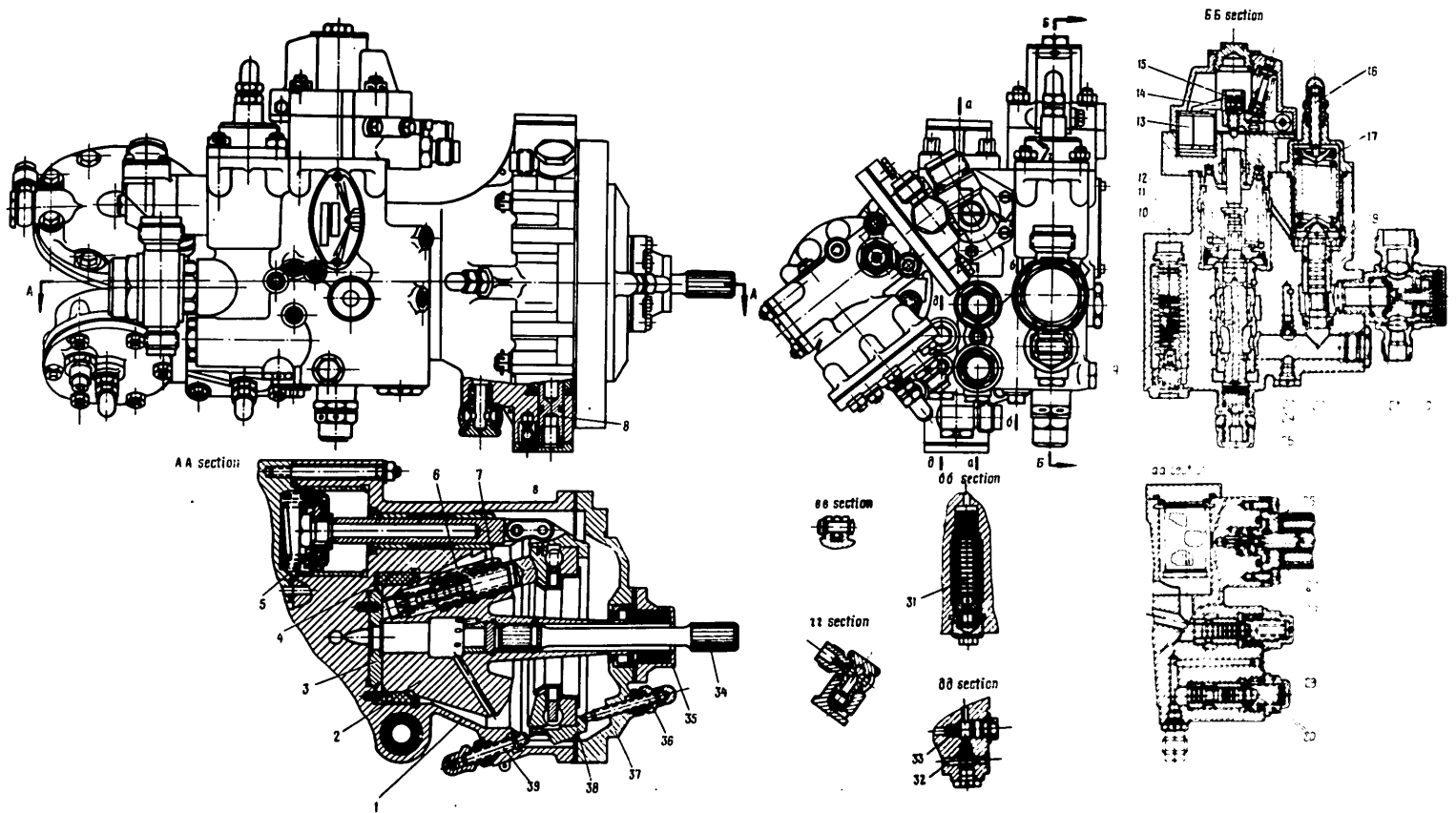


Fig. 45. HP-11BA Unit Assembly Drawing

- 1 - pump body; 2 - cover; 3 - rotor slide valve; 4 - rotor bearings copper-graphite; 5 - wobble plate cor-
 ruptor; 6 - plunger spring guides; 7 - plungers; 8 - wobble plate pin; 9 - fine filter; 10 - actuator valve
 corruptor; 11 - spring of actuator valve corruptor; 12 - switch rod; 13 - switch; 14 - switch lever;
 15 - switch adjusting screw; 16 - fuel valve adjusting screw; 17 - fuel valve spring; 18 - fuel valve;
 19 - fuel valve bushing; 20 - cut-off valve; 21 - cut-off valve seat; 22 - bypass valve jet; 23 - actuator
 valve bushing; 24 - actuator valve; 25 - air bleed valve; 26 - electromagnet; 27 - electromagnet valve;
 28 - electromagnet valve seat; 29 - bypass valve; 30 - constant pressure valve; 31 - flanging assembly;
 32 - corruptor jet; 33 - corruptor damper; 34 - shaft; 35 - gland bushing; 36 - minimum output screw;
 37 - rotor cavity cover; 38 - bearing body; 39 - minimum output screw.

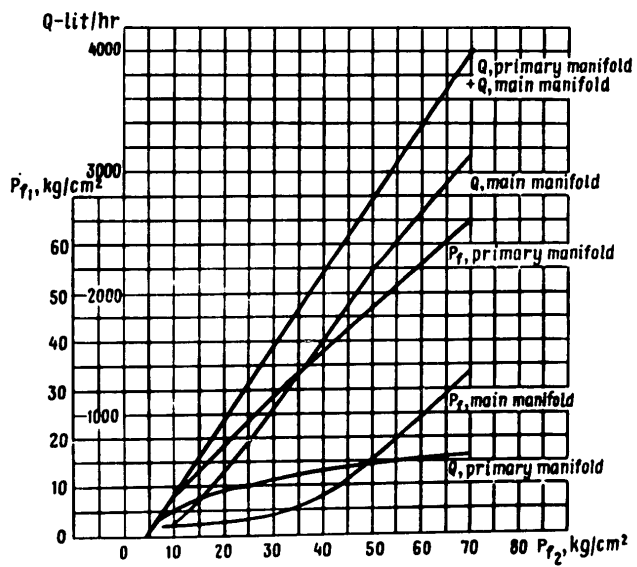
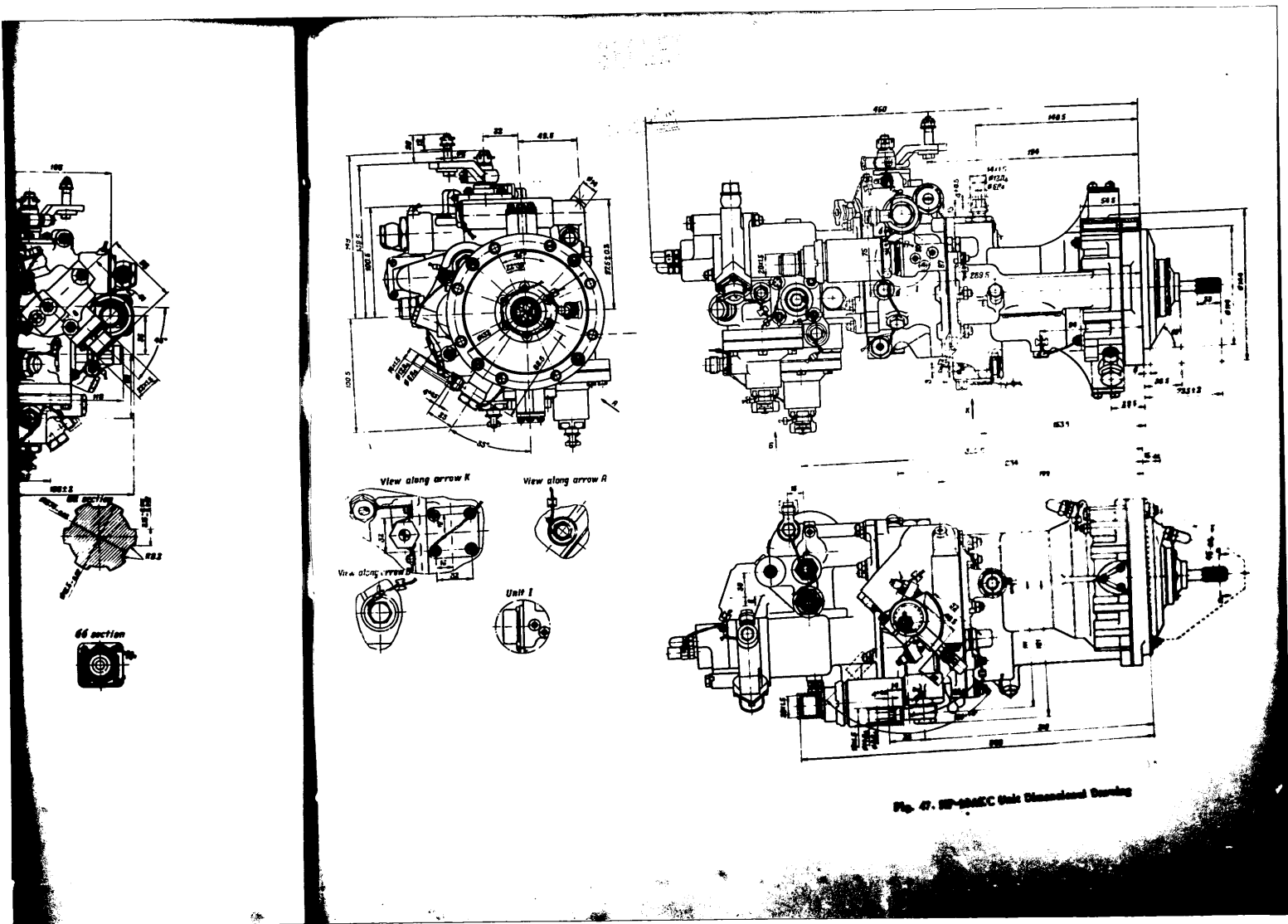


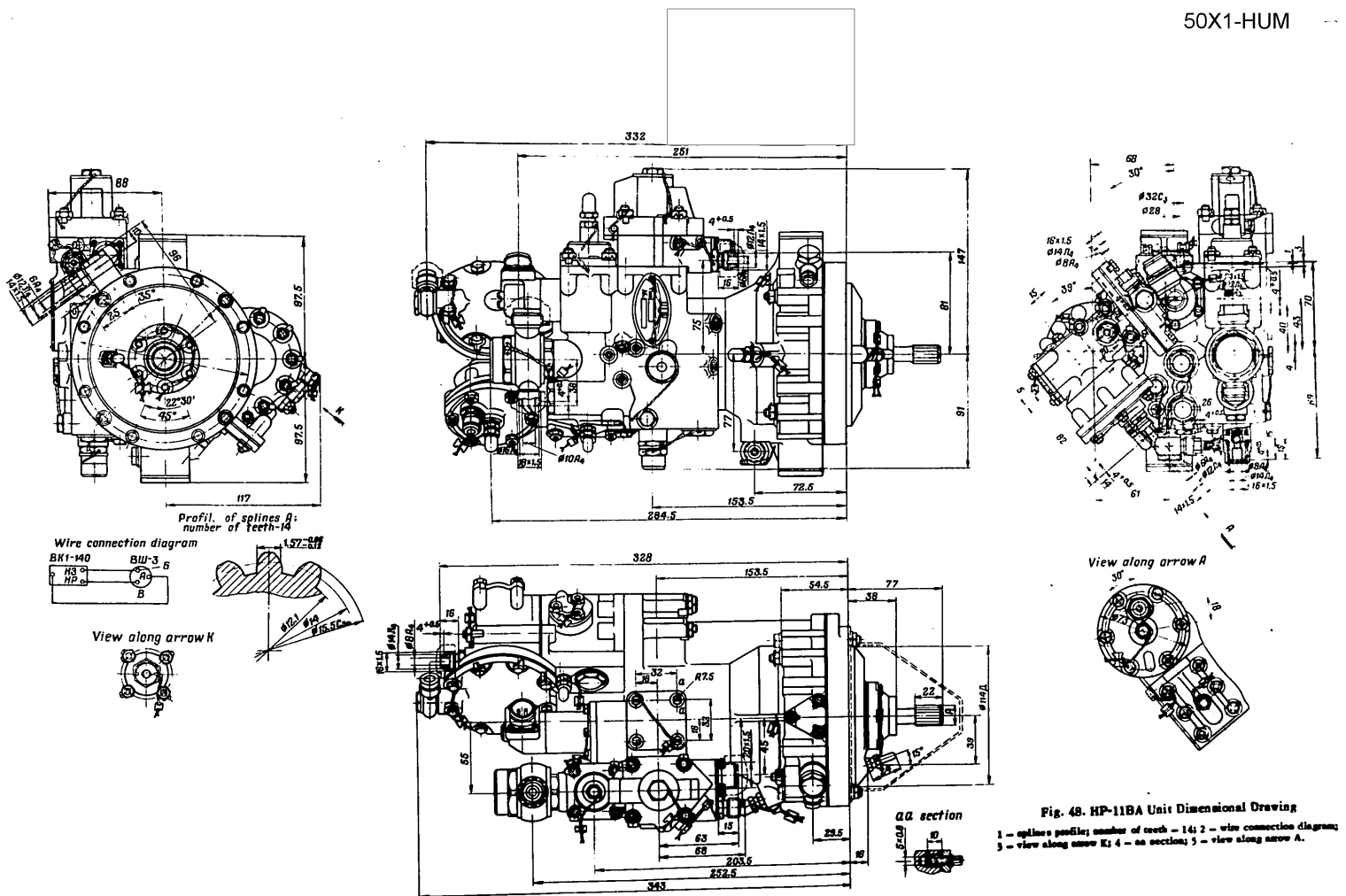
Fig. 46. Main Characteristics of HP-10A and HP-10AEC Units

P_{f1} - fuel pressure before burners; P_{f2} - fuel pressure before distributing valve.



50X1-HUM

50X1-HUM



50X1-HUM

50X1-HUM

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